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—Ben Osborn

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EDITORIAL

THE first annual meeting of the Soil Conservation Society is over. It was a good meeting. It was probably as good as any first national meeting ever held by a professional organization. The attendance was large, the prepared papers were excellent, and discussion from the floor was spirited. Things were learned that can make next year's meeting an even better one.

Although the soil conservationist could derive encouragement from the meeting, he could not fail to come away disturbed about some of the things he heard. An engineer spoke of controlling nature. Even maintenance of structures, he said, was a fight with nature, for a year's neglect might see the structures undercut —rendered useless. An industrialist said of soil conservation that it promised the blessing of man's dominion over the earth. How does this tally against the comments of an editor that the soil conservationist is setting an example by working with nature, not against her? Natural forces are powerful forces, and they influence every operation on the land. Is the soil conservationist working with them, or against them?

An editor asked: Is the soil conservationist prepared to face the prospect of a return to "surplus" agricultural production in the United States? How and where does the soil conservation program fit into such a situation? Will further soil conservation work add more to a "surplus" supply? Perhaps it will actually reduce the total supply. Or does the soil conservation program permit flexibility in production, as seems likely? If it is flexible, in terms of volume and kinds of agricultural production, how does it happen? Is there some practical method, within the framework of the soil conservation program on the individual farm, whereby the individual farmer may adjust the volume of production of certain crops and still make a living and protect his land?

Another thought comes to mind. Is the government able to tell us, or is it trying to learn anything about, the kind of agriculture we are likely to have when every agricultural acre is treated according to its needs and used according to its capability? We have a great national program dedicated to this objective. Wholly from the standpoint of physical considerations, there is ample reason to carry on such a program. But the physical world cannot be isolated from the social and the economic. When we adjust our agriculture to protect our physical resources, we will have done something to our economic and social life too. What?

What kind of agriculture will we have in the South, for instance, when the program is completed? And in the Cornbelt, the West and the East? What kinds and amounts of crops will then be raised, and what effect will all this have on the economies of these great agricultural sections? What, indeed, will the effect be on our national economy, our standard of living, and our social organization?

In short, where is the soil conservation program taking us? What will be the end result, in addition to conservation of soil and water resources?

To return to the matter of "surplus," is it possible, in fact, to have a surplus of food in a world where people starve? In India famine can be an economic failure because enough people have not died! In China mass starvation is periodically expected. In many lands diet is inadequate. In the United States each year 100,000 people die of pellagra and an increasing number suffer from diseases now recognized to be due to food deficiencies.

These and many other ideas brought out in the course of the meeting indicate that soil conservation is no small task. It recognizes no geographic barriers and its influence can tolerate no arbitrary lines between spheres of human activity. Whether we are up to the challenge —technically or idealogically—will be determined by the members of this Society and those who work with them.

The President's Annual Address

RALPH H. MUSSER

THE ADDRESS that follows was delivered by Ralph H. Musser, President of the Soil Conservation Society of America in Chicago, December 12-13, 1946. Mr. Musser has clearly set forth the objectives, activities, and future plans of the society.*

DURING THE period allotted to me this afternoon, I intend to discuss briefly, with you, the *objectives, activities,* and the *future* of the Soil Conservation Society of America. For some time many of us have been anticipating just such a meeting where we could review our objectives, discuss our progress, and consider plans for the future.

The thoughts I bring to you are by no means mine alone. They reflect the thinking and suggestions developed by many over a period of several years. To you who are assembled here and those who are not able to be with us, many questions have arisen relative to the science of soil and water conservation and the Society. Is soil and water conservation a science? If it is, why a new organization for its advancement? How can the science best be advanced? What can such an organization accomplish? What should be the program of the Society? Why chapters? Why can't the objectives of the Society be obtained through other organizations? It seems to me these questions are quite natural and logical. The composition of this two-day program and the discussions developed in it, I am sure, have answered most of your questions or will answer them before the program is concluded. In the future, many other questions will arise and most of them, I am certain, will be answered as we participate in and measure the accomplishments of the Society.

Conservation Is a World-Wide Movement

The Soil Conservation Society of America, we its membership, you and I—whose objectives are to promote and advance all phases of the science of soil and water conservation and to represent, advance, and protect its standards—stand on the threshold of a new era of challenge, responsibility, and opportunity.

The ever-increasing need to protect our most important physical resource—the soil—and insure its sustained productivity is the responsibility of everybody. Without question, the conservation of our soil and water resources has become one of the prime objectives and one of the major fields of endeavor in this country today. It is a movement which has grown to world-wide proportions.

In recent years great advancement has been made in soil conservation knowledge. Research, experience, and trials under actual field conditions have contributed much to the formula-

*The first national meeting of the Soil Conservation Society of America was held in Chicago, Illinois, December 12-13, with nearly 250 members, their wives, guests and representatives from seven foreign countries present.

The program was well planned and organized. Three panels, *"The Science of Soil Conservation," "Its Understanding and Acceptance,"* and *"The Science of Soil Conservation in Its Application,"* were featured. In addition, one entire session was devoted to the *"Technical Phases of Soil and Water Conservation,"* along with several outstanding papers. The Society banquet, honoring Dr. Hugh Hammond Bennett, the founder, was also a highlight of the meeting.

tion of this knowledge. Fortunately, widespread interest and activity in soil conservation has developed among people in all walks of life. Their interest and knowledge has been translated into action on thousands of farms, in hundreds of soil conservation districts and elsewhere. What has been done is only a beginning. The urgent need for action in the conservation of our soil and water resources is evident. The application of conservation measures will become more exacting. Knowledge must be clear and inclusive. In these activities the professional soil conservationist must play an important part. With him rests a great responsibility in pointing the way to conservation action. Through the advancement of the science and upon the performance of the conservationist we depend for the perfection of the work.

THE SCIENCE OF SOIL CONSERVATION

In its broad aspects, land is made up of soil, water, air, plant and animal life. To use it according to its capability, without waste, to treat and manage each acre according to its individual needs, and maintain its maximum productivity and use, is soil conservation.

The accumulation of certain knowledge which has been systematized with reference to the operation of general laws is science.

Such laws and systematized knowledge which apply to the conservation of soil and water is the science of soil conservation.

During the past 75 years, history has recorded the activities of many scientists and the progress made by them in their various fields in discovering facts and developing knowledge now recognized as pertaining to soil conservation. Time does not permit the discussion of these in detail. However, a debt of gratitude is due these scientists for their contribution to the science of soil conservation. Many of the members of this Society have made contributions, both large and small, in the fields of endeavor that are adding to the advancement of the science. Dr. H. H. Bennett is one of the scientists who early recognized the permanent soil destruction, its cause and possible remedies. He is a pioneer in soil conservation and in the advancement of the science of soil and water conservation.

History is recording the continuing progress being made in soil conservation. The recognition of soil conservation as a science, to my knowledge, was first recorded in 1939 when in his book "Soil Conservation" Dr. Bennett stated, "More concisely, the primary objective of this volume is to present a comprehensive statement of the science and practice of soil and water conservation." Today, Dr. Bennett is recognized as a great scientist and a world authority on soil conservation. His vision and recognition of the need of organized effort in advancing the science of soil conservation gave birth to the Society we represent here today.

PROFESSIONAL SOCIETY NEEDED

Since 1939, there have been numerous discussions regarding the need of such a Society. Professional soil conservationists numbered in the thousands. They needed a common meeting ground, a medium for joint expression, if the science was to advance in keeping with the demands placed upon them.

The then existing professional and scientific societies had been organized for other interests and purposes apart from soil and water conservation. Each, in turn, had made valuable contributions to the science of soil and water conservation in their separate fields, but nowhere was there provision in their organizations for the advancement of the soil conservation science, as such.

Other societies have dealt largely with the research aspects of the sciences. Too little attention was given to soil conservation research, its understanding and application. Conservation research is very important and necessary in the development of scientific knowledge. It is equally important that people be informed and understand the facts so obtained. Then, too, it is important that these facts and knowl-

edge are put to use, and applied where needed, through scientific methods, so as to be of practical value to the land owner and operator.

Facts, established through research or otherwise, are of little value unless understood by the land operator. The methods of informing him must be such as to inspire and arouse in him a desire to act. Neither facts nor information are of much value unless they result in application on the land.

Soil conservationists in seeking the greatest possible degree of unity and agreement among themselves on professional standards would naturally turn to a new organization—an organization having as its primary objective the promotion, advancement, and application of the science of soil and water conservation.

SOCIETY FIRST FORMED IN 1941

Out of these conditions, the American Society of Soil and Moisture Conservation was founded in Chicago, November 11, 1941. Temporary officers were elected at that time by its founders, but not until September 1, 1943, was its organization formally announced. At that time, temporary officers again were elected and qualified persons were invited to membership. In the world war period, because of travel restrictions and for other seemingly good reasons, it seemed impossible to hold an annual meeting in which all of the membership could have an opportunity to participate fully in the affairs of the Society. On December 6, 1944, the officers were re-elected and a temporary Council was formed. All agreed to serve until the first annual meeting.

During the period 1941-1945, another association was being formed, "The Soil Conservation Society of the Americas," for the benefit of the conservationists in Central and South America. Its membership extended into 12 of the South American countries. These two organizations joined hands in the formation of the new Society, covering all the Western Hemisphere, your organization—the Soil Conservation Society of America.

MEMBERSHIP IS FAR REACHING

Since December 6, 1944, the membership has grown to about 2,000 in the 48 states, in three territories and 17 countries. The territories are Alaska, Puerto Rico, and Hawaii. The countries include Brazil, Mexico, Ecuador, Chile, Peru, Haiti, Colombia, Costa Rica, El Salvador, South Africa, Honduras, New Zealand, Venezuela, China, India, Guatemala, and Canada. A constitution and by-laws have been ratified by the membership. Seventeen chapters have been organized and all have been granted charters.

Today, the Society is issuing two quarterly publications: "Notes and Activities" through which the membership is kept informed of events, activities, and internal affairs of the Society; the JOURNAL presenting the latest and most authoritative information about land use and the science of soil and water conservation. Factual material in the JOURNAL is styled to be interesting as well as enlightening so that it will develop a better understanding of soil conservation and create enthusiasm in the further advancement and application of the science. The JOURNAL provides a medium for the statement of issues whose discussions will further advance the science. It provides an opportunity for stating the position of the Society on controversial matters relating to soil conservation and the advancement of the science. It provides an opportunity for a membership forum in the discussion of such matters.

COMMITTEES ARE ACTIVE

Several national committees have been very active in developing sound organization principles, policies, programs, and management standards upon which this Society can stand and by which it can expand. These committees are:

Organization and Policy—Study organization and policies of the Society and make recommendations to the Council and membership.

Publication and Editorial—Make general recommendations to the Council on matters of publication and improvement of editorial policy, and to serve in an advisory capacity to the editor of the JOURNAL.

Membership—Encourage membership in the Society in all parts of the Western Hemisphere.

National Program—Develop a national program for the advancement of the science of soil conservation; make recommendations for local chapter programs and other activities which will further advance the science.

Glossary—Prepare a complete glossary of terms used by those engaged in the field of soil conservation.

Finance—In cooperation with the Secretary-Treasurer of the Society, review the possible sources of income, plan an annual budget, and make recommendations to the Council for the purpose of enabling it to keep the Society on a sound and continuing financial basis.

Program For First Annual Meeting—Plan the program for the first annual meeting of the Society and be responsible for the subject matter appearing in the program.

The membership, through local chapters, is developing programs and conducting activities which are commanding interest. Many subjects pertaining to the advancement of the science and the development of soil conservation knowledge are being discussed by them. The chapters, through their activities, will materially aid the Society in attaining its objectives.

INTEREST IN SCIENCE IS WIDESPREAD

A greater and widespread interest in the science of soil and water conservation is being realized not only by the soil conservationist but by other scientists and professional men in related fields of science.

There is a close relationship between: (1) the application and maintenance of soil conservation; (2) understanding and whole-hearted support by both rural and urban people; and (3) advancement in the science of soil conservation.

If citizenry as a whole is to realize the ultimate objective of the science—complete and firmly established conservation on the land—rural people must understand and appreciate the need, then act. Urban people, too, must appreciate this vital program and assist in such endeavors by accepting their responsibility in meeting land needs.

In the advancement of the science through research, experiences, and field trials, we must discover and establish facts, demonstrate practices, and provide information which will not only protect the land but which will inspire action in sound conservation. These efforts must be supported by organizations engaged in research, education, and application. All must contribute to this movement and bear their part of its responsibilities.

PEOPLE DEPEND ON THE LAND

Continued prosperity of both urban and rural people is dependent upon the sustained productivity of the land. Neither can prosper long at the expense of the other. There must be a mutual understanding of common problems and full cooperation by all people in solving them. Let me illustrate my point in the following manner.

The land owner and operator, in the final analysis, because he is the custodian of the land, must apply and maintain sound conservation on the land. United effort and cooperation is much more productive than individual effort alone. The farmer is well equipped to develop, guide, and direct organized efforts in soil conservation through his soil conservation district. Soil conservation districts are instruments of local government set up specifically for the purpose of enabling *farmers* to accomplish soil con-

servation. There are several farmer organizations organized primarily for purposes other than soil conservation, such as, the Grange, Farm Bureau, Farmers' Union, and other farmer associations, who can materially assist in this effort by working closely with the soil conservation districts.

All urban people must understand the land problems and lend their assistance. They, too, are well equipped to do this through organized effort. An example is the Friends of the Land, a non-partisan, non-political organization established for the specific purpose of informing urban people of the conservation needs and of developing in them an interest in the conservation program. It recognizes the need for a better understanding of rural problems in which rural and urban people have a joint interest and responsibility.

Many other urban organizations such as civic clubs, chambers of commerce, city farmers' clubs, professional organizations, schools, churches, garden clubs, conservation organizations, commercial and industrial organizations, and business, labor, and bankers' associations can well work with Friends of The Land in the accomplishment of these projects.

SCIENTIFIC APPLICATION IS NEEDED

Developments in the science of soil and water conservation must keep well in advance of needs by providing knowledge basic to conservation education and action. The Soil Conservation Society of America with the assistance of other scientific societies in related fields is well equipped to further this scientific progress.

In support of the foregoing activities—research, education, and application—such agencies and organizations as the Soil Conservation Service, Land Grant Colleges, through their experiment stations and extension services, other colleges and schools, conservation commissions, commercial organizations, and other state and federal agencies, are in a position to and should play an important role.

To the membership of the Soil Conservation Society of America may I say that I believe it is necessary, for the advancement of the science and attainment of the major objectives, that we give our support and assistance to the soil conservation district movement. We should support and participate in the activities of the Friends of The Land, and in other related organizations insofar as possible. As soil conservationists, we must spare no sacrifice in developing and advancing the science of soil and water conservation. We should solicit the assistance and active participation of other scientists and scientific societies in the fields of related sciences. We, in turn, should encourage and support the activities of other scientific societies in advancing the science of soil and water conservation.

OBJECTIVES OF THE SOCIETY

Accomplishment is the result of the willingness to strive for and a determination to attain stated objectives. To attain the objectives of the Soil Conservation Society of America will demand a sound and extensive program. To carry out such a program will require work—hard work—on the part of every member of the Society.

This organization provides a medium through which we should:

Exchange facts, experiences, and thought;

Develop, advance, and protect the standards of the science of soil and water conservation;

Support and assist in the conduct of a sound program of land use and soil and water conservation;

Encourage soil and water conservation research with emphasis where it promises tangible improvement in farming methods on a practical basis;

Provide a friendly forum to soil conservationists for the presentation and exchange of useful observations and experiences;

Encourage and foster discussion on pertinent matters of interest to professional soil conservationists;

Encourage all organizations to conduct forums and friendly discussion on experiences which will tend to improve the program of soil conservation and advance the science;

Stimulate development and use of the best scientific knowledge in and out of government circles on soil and water conservation and represent the professional conservationists' point of view wherever and whenever it seems advisable.

Encourage the dissemination of soil and water conservation information through the newspapers, radio, magazines, agricultural extension services, and other organizations, professional or non-professional, to bring about a better and increased understanding of soil conservation;

Encourage soil and water conservation education by all groups so there will be a better understanding and application of the science of soil conservation;

Encourage educational institutions to provide for soil conservation education in their curricula, to prepare young people to better understand and appreciate the needs in soil and water conservation so that they can assist in the advancement of the science;

Encourage student membership and student chapters in the Society;

Encourage the organization of additional adult chapters;

Recognize outstanding achievement in the development and advancement of the science;

Solicit the active participation in membership of those men and women who are professionally engaged in soil conservation work or in related fields of science and those who, through their work and interest, have furthered soil conservation and the science in a substantial manner.

SCIENCE BENEFITS ALL MANKIND

Advancement of the science of soil conservation and the conduct of a sound soil and water conservation program, firmly established, will be a great and lasting benefit to mankind. I am certain that this movement and the influence of this Society will eventually reach into all parts of the world.

To have served you as your president has been a real pleasure. Seeing this organization in its formation and having a part in formulating its foundation has been a real privilege. Its growth in membership and increasing number of chapters is most encouraging. Visualizing future accomplishments of this Society assures me that you will be proud to have had a part in it. I wish to express my appreciation to the other officers, the Council members, committee chairmen, and many others who have assisted in the many tasks that have confronted us. Each has given his full share. To them I give full credit for our progress.

I hope the officers you select today for the new year will have the full and hearty cooperation of the membership. The officers and governing body should be fully representative of the whole membership. They should be enthusiastic about the objectives and opportunities of this organization. They should be willing and in a position to give the necessary time to its affairs. Their administration of the Society affairs should give full consideration to all the interests of the membership. They should guide the development and performance of the Society along the lines of sound business principles. The development and advancement of the science, so that application and maintenance of complete soil and water conservation is realized, must always be a major objective.

The Soil Conservation Society of America must be aggressive in recognizing the importance of human security and its dependence upon sustained productivity of the land. Its activities must be governed by the unselfish and

(*Continued on page* 58)

The Scientific Basis for Conservation Farming

R. D. HOCKENSMITH

MR. HOCKENSMITH is Chief of the Conservation Survey Division of the Soil Conservation Service. His thinking has contributed greatly to the concept of the classification of land according to its capabilities, and he is the author of numerous articles and bulletins on the subject.

PROGRESSIVE farmers are now using a new approach to farming. They are adopting the idea that they must put each piece of land to the use for which it is best fitted. They protect each field and treat it so as to make it give the best product it can yield. In short, they have come to see that efficient operation of a farm calls for using land properly—according to its capability to produce satisfactorily and continuously.

Soil conservation is the art and science of using land according to its capabilities and treating it, according to its needs, to keep the soil permanently productive. But what are the capabilities? How do we know what the land needs? These questions have to be answered before real soil conservation can be practiced. A plan to fit the land cannot be made without knowing the kind of land, its needs, its limitations, the crops it grows best and how to keep it safe and productive.

Obtaining the Facts

A necessary first step, therefore, in making land use changes and in conservation farming is to obtain facts about the land. This is done for cooperators in soil conservation districts by marking on an aerial photograph the kind of soil, the slope of the land, the kind and degree of erosion damage, overflow hazards, wet areas, and such features as field and pasture boundaries, houses, roads, and streams. The soil scientist uncovers the subsoil layers with a spade, or bores into them with a soil auger. He examines the soil carefully to determine such features as depth of soil, color, texture, structure and permeability.

He notes the soil depth which determines the volume of soil available for plant roots to obtain nutrients and water. He knows that some plants are shallow-rooted and others are deep-rooted; also that a knowledge of the depth of feeding zone aids the farmer in selecting the crops best adapted to soils of varying depths. Major land uses (woods, grass, or cultivated crops) are often determined by the depth of soil. He shows the location of shallow soils, where land leveling operations may be wholly impractical, or where terracing methods may need to be chosen in accordance with the soil depth.

The soil scientist is constantly aware that the workability of the surface soil affects most of the things that a farmer does. It is related to the texture of the surface soil and also to the nature and degree of soil granulation. He carefully determines the texture of the soil by rubbing it between his thumb and forefinger. A coarse-textured soil is mostly sand. A fine-textured soil contains enough clay to make it sticky. Usually the medium-textured soils are most desirable and are adapted to a wider range in kind of crops. Tillage operations are usually more difficult on heavy soils, which require more care in handling than light-textured soils.

How fast water moves through a soil affects most of the cropping practices and conservation treatments. This depends upon how fine or how coarse the soil is and how well it is granulated. It depends also on the number and size of openings in the soil through which water passes. The rate at which water moves through the different soil layers is called the permeability. This is the rate of percolation. It should be distinguished from infiltration, which is the entrance of water into the surface layer of soil.

The soil scientist estimates permeability by observing texture of surface soil and subsoil, structure, consistence and color of subsoil, presence and thickness of a zone of compaction or induration, and the character of the underlying strata. His field observations are checked by occasional measurements of the rate of percolation, since the physical properties that he observes are clues rather than absolute guides to the permeability.

The ideal soil for the growth of most plants, as far as permeability is concerned, is one that permits plant roots and water to penetrate readily into the soil, allows the excess water to drain away, and retains enough water for plants between rains (or between applications of water by irrigation). The water available to plants depends, therefore, not only upon the ability of the soil to absorb water but also on its capacity to retain and later to release it to the plants. Also, permeability indicates the degree of aeration, which has an important influence on the development of root systems of plants. Excessively or very rapidly permeable soils allow much water to drain away and are the most droughty. Very slowly permeable soils retard the movement of water through the soil and retain the water so tightly that plants are unable to get much of it. When fertilizers are added to an excessively permeable soil, they are held

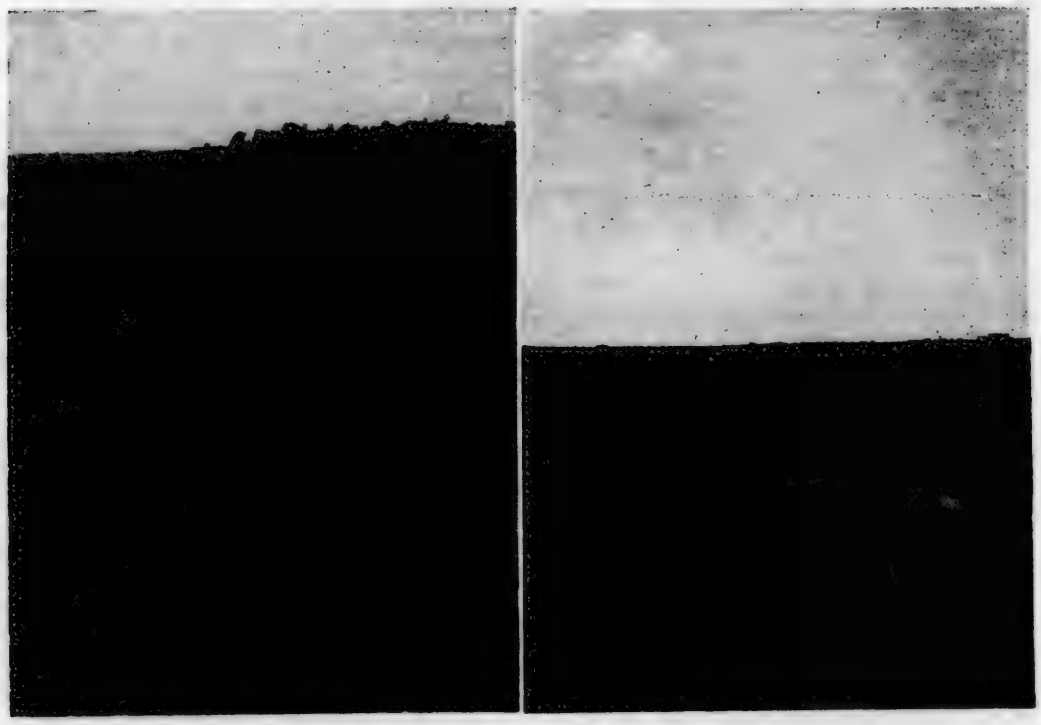


Figure 1.—An example of class I land. This land is highly productive, well-drained, and holds moisture well. It is nearly level and can be cultivated safely without special practices to protect it from erosion. Regular good management is all that is needed.

Figure 2.—Class II land yields well but is gently sloping and is subject to moderate erosion. Contour strip cropping and good crop rotations make this land produce more income per acre for labor expended and saves the soil.

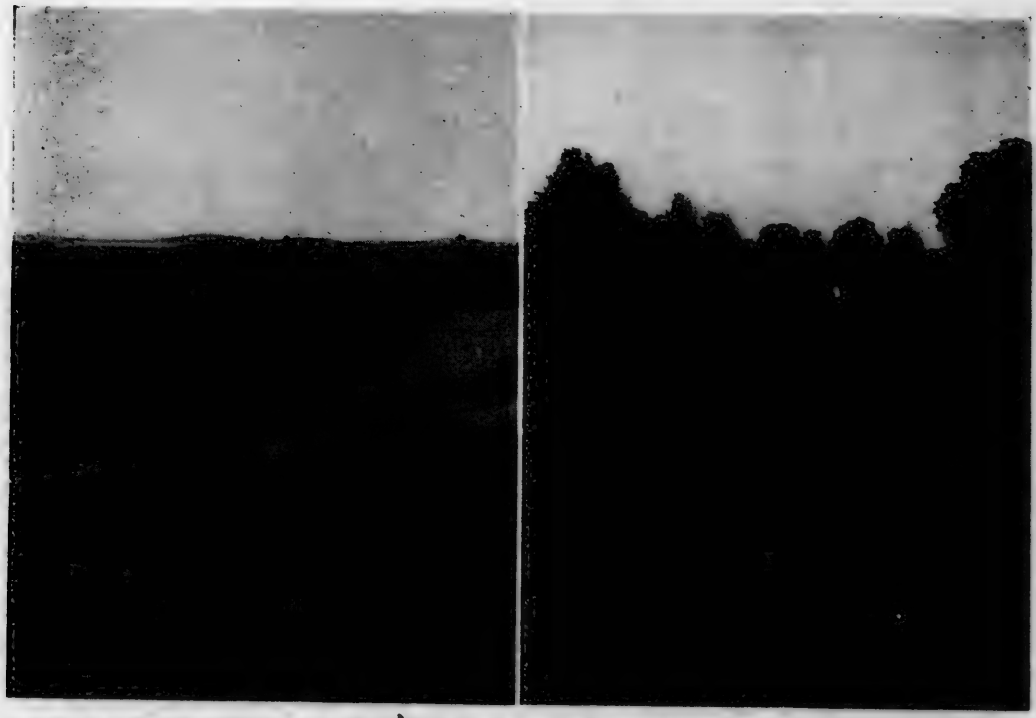


Figure 3.—Erosion is more difficult to control on this class III land with a 12-percent slope than on class II land. This land is protected, however, by a combination of terracing, strip cropping, and working the land on the contour.

Figure 4.—This moderately shallow, sloping class IV land is best used for hay or pasture. An intertilled crop may be grown here about once in 6 years as a step toward renewal of the stand of grass for permanent pasture.

so loosely they may be lost easily by leaching. In land drainage operations the permeability of the soil is extremely important in determining the depth and spacing of drains. The length of runs in the application of irrigation water is markedly influenced by the permeability of the soil. Runoff is usually greater on very slowly permeable soils than on those more permeable, thus more intensive erosion-control practices may be required. If the soil is rapidly permeable to water and also has good infiltration capacity, the rainfall soaks into the ground and very little water runs off. Generally, very slowly or very rapidly permeable soils are less desirable than the moderately permeable soils from the standpoint of soil-water-plant relationships. Permeability, therefore, plays a large part in the productivity of different soils, affecting the ease with which roots can penetrate, the rate of movement of water, and the resistance of the soil to erosion.

The color of the surface soil sometimes gives the soil scientist a clue to the fertility, organic matter, nutrient level or availability of nutrients in the soil.

Characteristics such as the danger of a bad overflow, a troublesome water table, stoniness, salinity and crusting are special factors which if present are noted on the map by symbols in addition to the soil symbol. The soil scientist records the slope of the land and the amount of soil that has been lost through erosion.

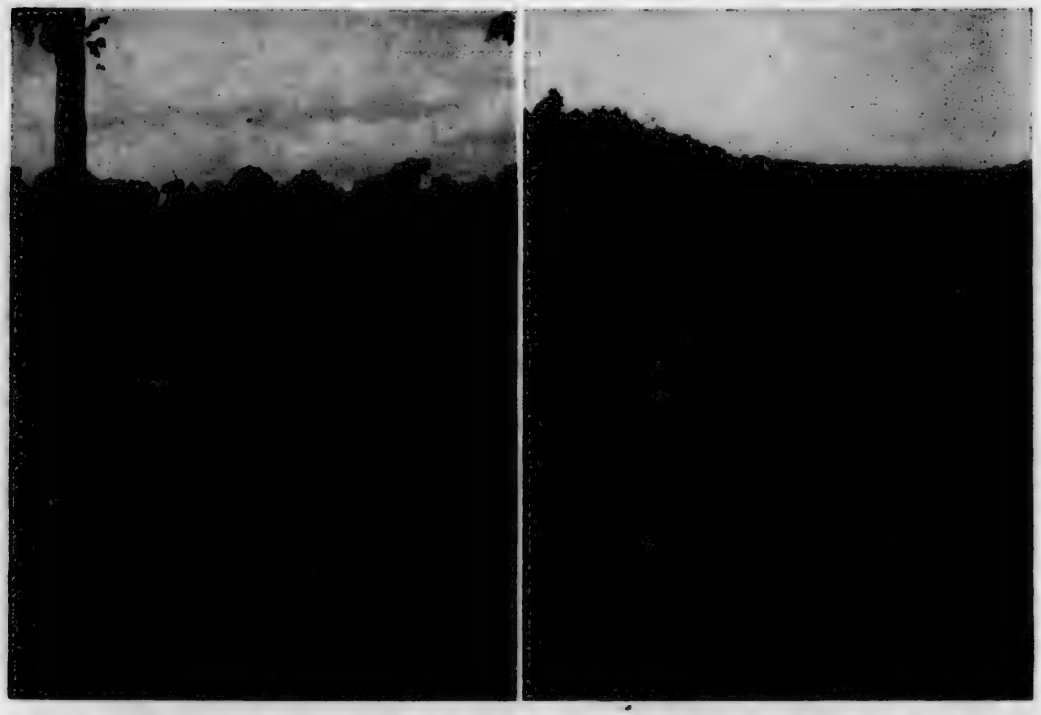


Figure 5.—An example of class V land. It would not pay to drain this land to make it suitable for cultivation, but it is good land for certain grasses. It is level and not subject to erosion.

Figure 6.—This class VI land, subject to very severe erosion, is not safe for cultivation. The kudzu provides excellent grazing and protects the land from erosion.

As he walks across each field, he draws accurate boundary lines showing the extent of each significant variation in the land. This is put on maps with a scale of 4 and sometimes 8 inches to the mile.

CLASSIFYING THE LAND

With the facts from the survey and a knowledge of the climate of the area, technicians are ready to classify the land according to what it can do and what it needs. That is, the land is classified in accordance with its capabilities. Local farmers, soil conservationists, soil scientists, and agricultural specialists work out together how the land should be used and land practices that they think are safe and sound for each land class. After they consider carefully all the information published or unpublished that can be obtained from experiments and demonstrations, they discuss each soil; its fertility, depth, workability and permeability; its behavior on different slopes; and its changes as erosion becomes more severe. Each combination of soil, slope and erosion is assigned to a capability class. Research findings and all technical information are blended with practical farm experience in determining the capabilities of the land and in working out the right combination of practices to make full use without waste of the land resources.

As a simple and effective guide in carrying out this basic principle of soil conservation, all land is divided into eight classes. On the basis of the work of thousands of agricultural spe-

cialists and literally tens of thousands of farmers, eight classes appear to be the most practicable and useful for the country as a whole. These classes range from the best and most easily farmed land (class I) to land that has no agricultural value except for wildlife (class VIII). They fall into three groups: Land suitable for regular cultivation, land suitable for only limited or occasional cultivation, and land not suitable for cultivation. The definitions of these eight classes show the best use (cultivation, pasture, woodland, wildlife) for each type of land and how to handle it for safe and permanent production. Classes I, II, and III are suitable for cultivation, class IV is suited to limited cultivation, and the remaining four are unsuitable for cultivation.

The eight classes are described as follows:

LAND SUITABLE FOR CULTIVATION

Class I: Very good land that can be cultivated safely with ordinary good farming methods (Figure 1). It is nearly level and easily worked. Some areas need clearing, water management, or fertilization. Usually there is little or no erosion. Most farmers, of course, find it necessary to follow those practices that will keep the soil in good condition and control weeds, diseases, and insect pests.

Class II: Good land that can be cultivated safely with easily applied practices (Figure 2). These include such measures as contouring, protective cover crops, and simple water-management operations. Common requirements are rotations and fertilization. Moderate erosion is common. Class II land is somewhat limited in

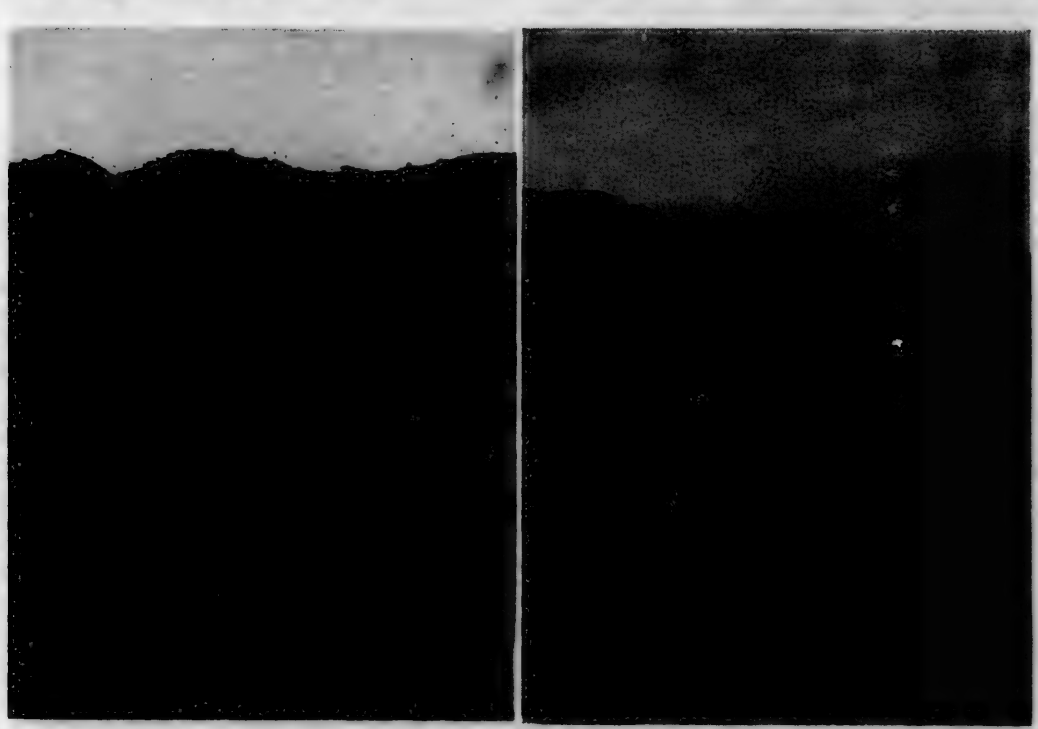


Figure 7.—An example of class VII land. This shallow, steep land is highly susceptible to deterioration and must be grazed with extreme care.

Figure 8.—An example of class VIII land. This land is unsuited for cultivation, grazing or forestry.

its use as compared to class I. In some parts of the country rainfall may not be enough to provide the full amount of moisture needed for crops and protective cover. In other areas the land may be level and slightly wet and require some simple drainage operation before it can be farmed safely for a long time.

Class III: Moderately good land that can be cultivated safely with such intensive treatments as terracing and strip cropping. Water management is often required on flat areas. Common requirements are crop rotation, cover crops, and fertilization. Usually it is subject to moderate to severe erosion. Class III land is more limited in its usefulness than class II. The limitations may be of the same kind as those of class II but present in greater degree. As a result, the practices are more difficult. Or it may be that they must be applied more intensively. The number of crops that will grow well may be somewhat less than on class II land. An example of class III land is shown in Figure 3.

LAND SUITED FOR LIMITED CULTIVATION

Class IV: Fairly good land that is best suited to pasture and hay; can be cultivated occasionally—usually not for more than one year in six. In some areas, especially those of low rainfall, selected land may be cultivated more than one year if adequately protected. When plowed, practices must be used carefully to prevent erosion. Class IV land is still more limited in its use than class III but may be useful for growing some cultivated crops. An example of class IV land is shown in Figure 4.

LAND NOT SUITED FOR CULTIVATION

Class V: Suited for grazing or forestry with slight or no limitations; needs only ordinary good management (Figure 5). Class V land is nearly level and not subject to erosion. It cannot be cultivated because it is wet, is rocky, is subject to overflow, or has some other drawback; but it is good land for grass or trees.

Class VI: Suited for grazing or forestry with minor limitations; needs protective measures (Figure 6). It is not suitable for cultivation. Most of it is moderately sloping and therefore subject to water erosion, or it is subject to wind erosion. Some class VI land has other hazards such as high water table or hardpan that make it less useful or need more careful management than class V. Fencing, spacing, watering places and salt, and limiting grazing are some of the protective measures needed. Contour furrows, ridges, and water spreaders may be needed to protect the land and increase the amount of grass.

Class VII: Suited for grazing or forestry with major limitations; needs extreme care to prevent erosion or destructive burning, or to overcome other hazards (Figure 7). Although class VII land can be used for trees or pasture it must be very carefully handled to prevent erosion or to overcome its limitations. Most class VII land is steep, rough, eroded, or highly susceptible to erosion. In other areas, owing to the low rainfall, the vegetation is so sparse that extremely careful management is required to protect it.

Class VIII: Suited only for wildlife or recreation (Figure 8). This land usually is steep, rough, stony, sandy, wet, or highly erodible. It is not suitable for grazing, forestry, or cultivation, yet this land is ideal for recreation and, comprising headwater areas, is of special importance in water conservation and soil conservation. Livestock is thus excluded not only as relatively unprofitable but also to permit the vegetation to protect the soil from washing down on the lower-lying cultivated land.

The land-capability classes may be subdivided to show the nature or type of the problem such as erosion control, water management including drainage, and fertilization. For example, in the lower Coastal Plain of South Carolina, class III land is divided into three subclasses, one showing an erosion-control problem, another a drainage problem, and still another a severe fertility problem. Subclasses are used only where absolutely necessary to show sig-

nificant variations in type of problem within a capability class.

The land-capability maps show the places on each farm where land-use adjustments should be made and where practices are needed to protect the land. More specifically, the soil conservation survey and land-capability maps show:

1. Areas eroded or subject to erosion requiring suitable erosion-control practices.
2. Wet lands, and their suitability for use if drained.
3. Location of spots affected by toxic salts and the ease or difficulty of leaching out salts by flooding.
4. Areas needing manure, fertilizers and lime.
5. Fields that should be changed from cropland to grassland or trees.
6. Grassland that can be used safely for clean-tilled crops.
7. Organic soils (peat and muck land) requiring protection from fire by flooding or by raising the water table.
8. Areas subject to frequent flooding.
9. Patches of otherwise good bottomland covered with erosion debris.
10. Areas too steep or shallow to cultivate on which trees or grass should be planted.
11. Location of fence or field boundary changes needed to farm land according to its best use.
12. General location for terrace outlets.

Figure 9.—A landscape that illustrates seven of the eight land-capability classes: I, II, and III, regular cropping; IV, pasture and hay; VI and VII, grazing; VIII, wildlife and recreation.

13. Peculiar soil areas not suitable for terracing.
14. Rock and gravel outcropping that interferes with farming operations.
15. Fields with soils too shallow to level.
16. Location of soils best suited for particular crops such as alfalfa, tobacco, peanuts.
17. General location for pond sites and need for protection of slopes above to have clear water.
18. Location of soil material suitable for conservation of dams for ponds.
19. Need for and location of special gully-control treatment.
20. Basis for field arrangements and location of lanes, roads, and fences to best utilize pasture and crops.
21. Basis for estimates on quantity of conservation practices to determine kind and amount of labor, equipment, and materials required to apply the practices.

USING THE LAND CAPABILITY MAP

Let us see how a land-capability map[1] of a farm is used by a farm planner and a farmer in making a farm conservation plan:

They first look at the map to get a good picture of the entire farm. Then they walk over the farm, and the farmer points out the problems that are bothering him and the places on his farm where he needs help. These may include a bad gully or a field that is not producing as well as he thinks it should. He wants to know what it needs. Together they refer to the map to see clearly what each part of the farm can do and what it needs. They talk about the different kinds of land. The farmer points out his different crops. He explains what he wants to do. They look frequently at the land-capability map to see how each parcel of land can be used safely and at the same time produce what the farmer wishes in order to get the most from the farm. They select the cropland from classes I, II, and III. This may mean retiring from cultivation the class IV land and breaking out of sod some class II land. Land of class V, VI, and VII may be used safely for pasture and farm woodlots. The needed erosion-control practices are discussed at the spot on the farm where they belong. Terrace outlets are located. Farm pond sites are selected. They agree on treatment of slopes above the pond to provide clear water. Lanes, roads, and fences are changed if necessary in order to follow the contours of the land.

The farm planner and the farmer mark on another aerial photograph the use and treatment agreed upon for each field. This second map shows the new arrangement of fields, fences, and roads. It specifies what each field is to be used for. It shows the location of the water-disposal system and the protective measures that are needed for each field. Along with the land-capability map and the land-use map the farmer receives one copy of the jointly developed recommendations for handling each field. Such jointly developed recommendations may be written directly on the land-use map or may be noted on a separate sheet. Thus, he has a "farm conservation plan" for the kind of farming he wants to do based on the capabilities and needs of his land. He keeps the farm conservation plan including the two maps for reference. He may even wish to tack the maps on the wall and use them for many years as he carries on his farm operations. The land-capability map shows him what the land is, and helps him farm to fit the land. It is a constant reminder to him why the different conservation measures are needed. It tells him that his land may be damaged permanently unless he puts it to its proper use.

[1] Colors distinguish land-capability classes on the maps. A nation-wide system shows each class as follows: Class I, light green; class II, yellow; class III, red; class IV, blue; class V, dark green; class VI, orange; class VII, brown; and class VIII, purple. Subdivisions of classes are shown by patterns. Symbols show the soils, slope classes, erosion conditions, and related physical land information.

Panel Discussion*——

TECHNICAL PHASES OF SOIL AND WATER CONSERVATION

An Abstracted Report of Papers Presented

FIRMAN E. BEAR

DR. BEAR, Editor of *Soil Science* and Chairman, Department of Soils, College of Agriculture, Rutgers University, presided over the panel discussion which featured the *Technical Phases of Soil and Water Conservation*. This abstract gives the highlights of the six papers presented on the panel.

IT IS NO LONGER necessary to argue about the need for soil and water conservation. The accomplishments of the Soil Conservation Service and affiliated federal, state, district, and private agencies in awakening public interest and concern and in getting effective conservation programs under way speak for themselves. The handwriting of erosion has already been erased from many acres of land. But all those who have had to do with this tremendous project realize that a great deal more mental and physical effort must be put into it if we are to solve the many problems that are involved.

"There is a tide in the affairs of men that, taken at the flood, leads on to fortune." The conservation program is in the flood stage. It is time now to bring to bear the best thought we have to the end that as few mistakes as possible are made and full advantage is taken of the widespread current interest in this subject.

In planning a program on the technical phases of soil and water conservation it was necessary to break the general topic down into several parts. For convenience these parts were designated: *soils, cropland, grazing land, woodland, engineering,* and *wildlife*. Each of these will be discussed by a man who has given a great deal of thought and attention to the subject. The speakers, in the order of their appearance, are:

R. J. Muckenhirn, Professor of Soils, University of Wisconsin.

Grover F. Brown, Chief Agronomy Division, S.C.S., Washington, D. C.

B. W. Allred, Chief Regional Range Div., S.C.S., Fort Worth, Texas.

Edward N. Munns, Principal Silviculturist in Charge Division Forest Influences, Forest Service, Washington, D. C.

George D. Clyde, Chief Division Irrigation and Water Conservation, S.C.S., Logan, Utah.

Warren W. Chase, Prof. Wildlife Management, University of Michigan.

Soil Management Frontiers

R. J. Muckenhirn

Unparalleled amounts of energy are now being applied in soil tillage operations. The number of tractors in the United States increased four-fold from 1925 to 1945. The use of such

*This issue of the Journal contains several papers, including a summary of the technical session, presented at the first annual meeting of the Soil Conservation Society of America. Other papers will be selected for publication in future issues of the Journal. It will be impossible, however, to publish all the papers presented at the meeting. In case a member of the Society wants to obtain an unpublished paper, a request should be made to the Editor of the Journal or direct to the author.

equipment over the land may in some cases seriously damage the aggregation and porosity of the soil but it will make possible tillage of and the incorporation of lime and fertilizer into the subsoil. Mechanical power is being used for operating rototillers and weeders with revolving claws or augers and these may be extremely useful under some circumstances.

By the direct application of ammonium solutions it may become possible to apply nitrogen at a cost of four or five cents per pound, or at one-half the present cost. It might be economical on high-priced land intensively cultivated, to supply all of the nitrogen artificially rather than through legumes. If this were done, grasses fertilized with nitrogen might then be grown to better advantage for improving the soil granulation, although they probably would not exert as much influence on the subsoil as deep-rooted legumes. The maintenance of sodded orchards would become more practical and the maintenance of a sod would practically eliminate erosion. The mixing of ammonium solutions with irrigation water is undoubtedly feasible.

A continuing intensification of management will require greater detail in soil maps for technical use. Further efforts toward summarization and simplified classification for general purposes will be made. New research methods will provide information on the effects of climate on soil and plant. The evaporation from a broad expanse of crop or soil, either cultivated or uncultivated, can be measured by evaporimeter techniques described by Thornthwaite and others. The actual vapor loss from forest or grassland and from fields tilled in various ways will be determined directly. Radar instruments can be used to plot the distribution of the many discontinuous showers which make up a general rain. A further application of radar probably will make it possible to estimate the average size of the rain drops, a factor shown to be of real importance in determining the rate of erosion.

Soil stabilizers used to surface airport runways during the war might be useful as temporary protection of terrace outlets and waterways. The use of paper or fiber netting for the same purpose is well within the realms of possibility. A paraffin compound which protects the soil but allows seedlings to sprout through has already been tested.

DDT and other new insecticides offer hope that legume seed production can be increased greatly, thus lowering the cost and promoting the more general growing of legumes in rotations and pastures. Chemical weed killers and weed-burning attachments now being tried in the field may eliminate the need for tillage of certain crops and make possible the maintenance of mulches of crop residues even in row crops.

THE TECHNICAL BASIS OF SOIL AND WATER CONSERVATION ON FARM LAND

Grover F. Brown

The basis of conservation farming is using land in accordance with its capabilities. Land capabilities are determined by the present productive capacity of the land and the relative difficulty of maintaining this productive capacity. Our classification and use of agricultural lands are largely governed by soil erosion.

Soil erosion involves both detachment and transportation of soil. If we check either of these processes, we check erosion. In some fields we find it most important to protect the soil surface from the impact of raindrops. We can do this with a cover of living vegetation such as grass, hay, small grains, and legumes. We may accomplish the same purpose by leaving a covering of the previous crop's residues on the soil surface. Such a blanket not only protects soil particles from being forcefully torn loose but also helps prevent their being transported or moved very far from their original home. Adequate cover keeps the soil in condition to absorb water and protects it against erosion.

In practical conservation farming we try to balance the soil-destructive effects of some crops

with the soil-building or soil-conserving effects of others so that permanent deterioration will not take place. We try to expose the soil surface only so much of the time as is necessary and only during those seasons of the year when damage from raindrop or wind action is least likely to occur. Progress is being made in finding cover crops that will grow and produce seed during the part of the year when the row or cash crops are not occupying the land. Once such cover crops become established and fill the soil with their seed they automatically come back to protect the ground surface when needed in the row-crop year. This development relieves the farmer of having to reseed his cover crop and helps to assure that a protective cover crop will be obtained regardless of availability and price of seed or of work load in other jobs.

CONSERVATION OF GRAZING LANDS

B. W. Allred

A panorama of the American grazing scene throws into relief a maze of intriguing patterns that reflect differences in the environment and in many related factors. There are over 1,918 million acres of land in the United States practically all of which provides forage for useful animals part of the year. These include: 8,259,000 horses; 3,196,000 mules; 75,791,000 cattle; 44,241,000 sheep; over 3,000,000 goats; 62,344,000 hogs; 525,536,000 chickens; 8,734,000 turkeys; 6½ million big game animals; and many million meat-producing birds and small game animals.

U. S. Senate Document 199 reported in 1936 that western range forage production had been cut from one-third to more than two-thirds over large sections in 70 years. Other problems that plague the grazing interests all over America are: siltation, unequal tax burdens; insecure and undesirable land tenure; and intermingled land ownership.

Range deterioration has a long start. To overtake it we must invade the situation with all of the force and vigor that we can master. Carefully planned research will provide helpful answers. Some of the important problems are: artificial seeding; natural plant litter or mulches; selection and perfection of high-producing regional strains of forage plants; and evaluation of biological relations to grazing land.

Imperfection of devices for diffusion of useful knowledge on grazing to landowners is largely responsibe for the present condition of our grazing lands. Information must be conveyed in common language to the grass-using public. No common language has been developed for grass like that for cattle, sheep, corn, and cereals. Our historic lore and traditions have developed around pioneers, plows, rivers, forests, and cowboys.

FORESTS IN SOIL AND WATER CONSERVATION

E. N. Munns

Forestry was practically synonymous with conservation in its early development. It was recognized that forests had value in connection with the solution of the problems of flood control. Forests conserve water supplies, provide high quality water, retard flood flows, increase ground water, maintain summer flow, and provide good fishing.

Forests do not greatly affect precipitation. They use water, intercept precipitation, reduce evaporation, protect the soil, enrich the soil, retard radiation. The yield of water can be increased by cutting, by maintaining a uniformly light stand, by changing from high to low types of trees and by planting snow traps.

Where flood control is needed, conifers should be substituted for deciduous trees and timber type for coppice forests, and a dense understory of small trees, bushes, and grass should be encouraged. By so doing the transpiration and infiltration rates can be increased and surface run-off reduced.

But forestry is concerned with soil as well as water conservation. The manner of removing logs can be so damaging in inducing gully-

ing as to offset the advantages of forest growth. Similarly the roadways through forests often are built without regard to the erodibility of the soil. Forest vegetation alone will not conserve soil and water. Engineering methods and structures are also necessary.

Grazing is causing a great deal of forest damage in many areas by compacting the soil, killing out minor vegetation, and permitting increased runoff. Grazing damage is not conned to domestic animals but to lack of control of wild game. Both types of animals tend to concentrate on certain areas probably by reason of the better mineral quality of the produce. Possibly better distribution could be effected by the use of the right kind of fertilizers.

Forests control erosion probably better than any other type of cover. But foresters do not yet fully recognize the extent to which proper management can be made to be positive agents in soil and water conservation. The Soil Conservation Service is making a highly important contribution to the thinking of foresters in this connection.

ENGINEERING ASPECTS OF SOIL AND WATER CONSERVATION

George D. Clyde

The great basic resources of any country are its soil and water. Their conservation involves control as well as use. In humid areas the problem is one of safe disposal of the excess water. In the arid regions it is one of conservation of use. In either case vegetal cover and land use are important but physical structures built by man are necessary for maximum control and use of these resources. Before adequate engineering structures can be designed, however, reliable information relative to the precipitation and hydrologic data related to runoff characteristics must be available. Each water shed is essentially a law unto itself.

Water control structures are essential both on the high water sheds where streams converge to concentrate the flow and on the lower reaches of the water sheds where large quantities of water must be provided for. These include terraces, gully head plugs, checks, debris basins, contour furrows, ditches, spreading structures, brush wattles, spillways, drops, grass channels, stilling ponds, and revetments. No engineering structure should be planned and constructed unless adequate provision for maintenance is provided.

In the arid west all control structures and engineering applications are directed toward the maximum utilization of water rather than to its safe disposal. Ordinarily the maximum of stream flow does not occur when the plants need the most water, so the natural runoff must be stored. Where storage is not available attempts are made to predict the annual flow and its seasonal distribution for such crops as can most likely be matured with the supplies of water available.

Application of water to the soil involves measuring devices, checks, drops, headgates, sand traps, pumping plants, sprinkler nozzles, spiles, and syphon tubing. Land preparation is important and probably represents the greatest opportunity for conserving water supply, reducing soil erosion, and increasing farm profits through a reduction of irrigation costs. Conveyance of water from river diversion to the farm often results in heavy loss of water. Canal linings aid greatly in the reduction of such losses. The problem of gravel on the bottom of the channel is being solved by the installation of sand traps near the canal intake and that of moss by the use of chemicals.

In many areas ground water is a principal source of irrigation supply. When ground waters are depleted artificial recharge must be resorted to. In other areas reclamation of water logged and alkali land is involved. Engineering methods, practices, and structures are an initial part of all these soil and water conservation programs but they are fully effective only when they are an integral part of a complete set of practices involving plants, animals, soil, water, and people.

WILDLIFE CONSERVATION

Warren W. Chase

A working knowledge of the life history of wild, vertebrate animals is essential for their sustained production. This calls for a study of where they live, what they eat, what kind of cover they require for each season of the year, and the needs of the different sexes and age classes. Resourcefulness in working with people is also involved.

Wildlife has been developed as a part of the conservation program because it meant another voice to better land use, it added a touch for the urban peoples, it aroused the interest of hunters and fishermen, and it benefited from the work of other conservation programs.

In developing its part of the program, wildlife received its greatest aid from ideas on land use, development of land-use capabilities, expansion of the concept of ecology, synthesizing practical conservation practices, and modifications in standard agricultural practices. Out of these grew the concept that certain kinds of land should be designated as wildlife land.

The most useful tool has been found to be ecology. It was not a new tool but a new use was found for it. Thus the matter of natural plant and animal succession and the natural adaptability of plants and animals to poor and rich soils came under careful scrutiny.

Viewpoints on Conservation of Grazing Lands

B. W. ALLRED

B. W. ALLRED is Chief of the Range Division, Soil Conservation Service. His headquarters are at Fort Worth, Texas. Mr. Allred's paper, presented on the technical panel, clearly outlines the problems and needs confronting the grazing lands of the United States.

EARTH BROUGHT forth grass," Genesis 1:12.

A panorama of the American grazing scene throws into relief a maze of intriguing patterns that are influenced by climate, culture, geography, physiography and custom over the whole of the United States. There are over 1,918 million acres in the United States, practically all of which provide forage to some kind of meat animal part of the year.

GRAZING HISTORY IN THE UNITED STATES

America is an ancient pasture. The Jura-Triassic and Cretaceous beds hold the fossils of giant herbivorous dinosaurs and the fossil trees and herbs on which these voracious animals grazed. Then came the great Laramide Revolution and contemporaneous uplift of the Rocky Mountains which concluded the reign of dinosaurs and their disagreeable kind. Ancestors of both mammals and grasses appeared about this time. Some authorities believe that grasses are the lineal descendants of Cretaceous sedges. The evolution of grasses in the Great Plains region of America apparently coincided with the evolution of the horse, camel and many other grass-eating mammals which originated in America during the Eocene geological period.

The ancient land bridge across the present Bering Sea is believed to have been the pathway over which grass-eating mammals and other animals communicated between Asia and America. And during the interglacial periods, Asiatic animals crossed the Bering land bridge. Many of their descendants, which include the Bighorn sheep, Rocky Mountain goats, and others, found

their way southward along the Old North Trail which came up the Yukon Valley. From there, it led over the low pass into the McKenzie Valley and southward to the Great Plains. While the million North American Indians of the Pre-Columbian era had domesticated dogs and turkeys, they also hunted the wild grazing mammals like buffalo, deer and elk. Around the kitchen middens of Ancient Yuma and Folsom man has found the cracked bones of horses, camels, bison and Ice-age elephants. It is not known why, but camels, horses and elephants disappeared from America in the late Ice-age.

European horses were introduced to horseless America in sailing vessels by Cortez to Mexico in 1515 and DeSoto to Florida in 1539. Around 1540 the descendants of horses which had escaped the Spanish conquistadors and run wild were being tamed and ridden in southwestern Indian villages. By 1760 horses were being used by the Indians from the Rockies to the eastern prairies and hardwood savannahs. Prairie and Plains Indians were hunting on the descendants of the horses brought over by the conquistadors 100 years before they came into active contact with white settlers from eastern United States.

American stockmen moved their herds westward from the eastern seaboard as the farmers' plows nudged them on in search of grass. The grassy glens and glades of the Piedmont frayed out and connected with a network of Indian and wild animal trails that led across the Mississippi Valley, the Black Hills, and Rockies to the Pacific. The paths followed the great rivers inland. One wound up the Potomac, through the Cumberland Gap, and over the passes in the Appalachians. From there, the trails led down the Ohio into the bluestem prairies, up the Missouri and Platte, and finally westward. The glades in Virginia were connected by grassland routes along the rivers, over the grassy balds of Tennessee and Kentcky. From there, the trails led to the limestone prairies and plains of Alabama, Mississippi, Arkansas, Oklahoma and central Texas to the prairies and plains, the dry center of America.

THE GRAZING LANDS

Great plant communities are the product of their environment. Within broad temperature belts, precipitation is the greatest controlling factor of the environment. Forests have high water requirements and therefore occupy the bulk of eastern United States where rainfall is high. Mid and tall grasses are next in demands on water for growth. They occupy the savannah next to the western edge of the forest and extend westward to join the mid and short grasses on a broad tension line along the 100th Meridian. Rainfall is also high enough to support forest communities in the northwest and on the divides and peaks of the Rockies and other western mountains. The wet winter and spring and dry summer climate of the northwest favors the growth of cool season grasses that develop in early spring and mature before the dry summers set in. The cool season wheat grasses, fescues, blue grasses, and sedges comprise the bulk of the climax plants of this area. These plant communities prevail with certain variations southward along the flanks of the western mountains almost as far south as Mexico. The desert plains grassland of southwestern United States and northern Mexico has a summer growing climate. Hence, the warm season grasses like the gramas, Hilarias and dropseeds dominate. In the desert regions along the Mexican border in Arizona and California where there is less than six inches of rainfall, small shrubs are the reigning climax plants.

INTERLOCKING GRAZING AND CROPLAND INTERESTS

Together, the grazing and farming resources make up the pattern of agricultural production over the nation. Use of grazing land seldom is completely pastoral but usually inter-related with a maze of agricultural pursuits. Wise management of the large area of United States grazing lands is imperative to security and improvement of soils an such land itself. This also affects the welfare of the United States hydro-electric developments, wildlife and recrea-

tional resources, forests, western irrigation agriculture, town and city supplies, inland water transportation, and security of industry.

GEOGRAPHICAL AREAS

There are three major geographic areas that are distinctly different grazing provinces:

1. *Western Grazing Lands*

The grazing land of the 17 western states compose about 40 per cent of the land area of the United States. Most of it is grazed by meat-producing animals. Almost one-third of the nation's feeder cattle and one-half of the feeder lambs, that are finished in corn belt feed lots and California irrigated pastures, originate in the west. The range livestock industry has been specialized to provide feeder cattle and sheep that are of suitable grade and quality for finishing purposes.

2. *Southeastern Grazing Lands*

The potentialities of southeastern grazing lands are coming to light. In the Gulf Coast area of this region alone, there are 220 million acres of which 130 million acres, or 60 per cent, is forest land, most of which is grazed part of the year by cattle and some sheep. In 1943 this area produced about 1 billion pounds of beef, an amount equal to ¼ of the United States military needs and for lend-lease purposes. With prudent management, the glades, prairies, forests, cutover land, marshes, bayou and levee banks can be grazed safely and fire hazard reduced.

3. *Northeastern Grazing Lands*

Roughly, one-half or more of the nation's domestic livestock and game are found in the northeastern grazing lands composed of the Corn Belt, Lake States, and the northeast. Except in the woodland pastures, native grasses have practically disappeared and the remaining pastures are made up largely of introduced cool season grasses and clovers from Europe. Cereal grains and legumes are also in common use in places for annual pastures.

MEAT PRODUCTION ON UNITED STATES GRAZING LANDS

The United States Government is the largest single landlord in the nation, and the bulk of its lands are only suited to grazing, forestry, or recreation. Although the wild animals in national parks are not generally killed for human food, the parks serve as natural wildlife nurseries as the overflow reaches outside ranges where hunting is permitted. Agencies of the Interior and Agricultural Department manage approximately 441 million acres.

It is reported that about one-half of the food of domesticated animals comes from native forage and about one-half from farm crops, which include grass and legume hay from about 70 million acres of hay land. The bulk of wildlife food comes from natural sources. With all of the progress made through chemurgy, nothing has yet been engineered that can convert the blades of grasses, sedges and twigs of other plants into useful human products as efficiently as the cow, sheep, and numerous other farm and wild animals. The domesticated animals of the United States that obtain part or all of their food from grazing land include:

8,259,000 horses; 3,196,000 mules; 75,791,000 cattle; 44,241,000 sheep; over 3,000,000 goats; 62,344,000 hogs; 525,536,000 chickens; and 8,734,000 turkeys.

In addition, these same grazing lands support the following big game animals:

Deer	6,089,172
Woodland caribou, elk and moose	248,652
Prong-horned antelope	199,385
Bighorn	15,325
Mountain goat	16,395
Peccary or javelina and European wild boar	55,353
American bison or buffalo	4,980
Total	6,629,272

There are several million meat-producing birds and small game animals, also, which live on grass and other closely associated forage plants.

CONDITION OF GRAZING LANDS

Grazing land depletion continues apace over large areas of the nation. There is some local improvement which is minimized by widespread losses all around. The greatest exception is found in the Great Plains, particularly the northern part where drought-ridden ranges of the 1930's have recovered with almost miraculous speed the last eight years. Forced reduction of herds during drought and unusually flavorable climatic conditions since provided the exceptionally rugged grasses of this area a chance to flourish. Approximately six million acres of depleted ranges, abandoned farm land and farm pastures in the western United States have been seeded within the past 10 years to perennial forage plants. Nearly five million acres of perennial forage plants have been established on Soil Conservation Districts and Title III Jones-Bankhead land in the country as a whole. Soil conservation districts have plans under way to double that amount immediately.

U. S. Senate Document 199 reported that in 1936 western range forage production had been cut from one-third to more than two-thirds over large sections in 70 years. While there is a vigorous interest in pasture improvement in the south, middle west and northeast, the native grazing lands of this vast area are probably in poorer condition than the western grazing lands.

There are also other problems which plague the grazing interests all over America, besides decline in native vegetation. Soil on bare ranges and pastures is washing away in muddy runnels and clogging rivers and channels; grazing lands bear an unequal share of the tax burden; insecure and undesirable land tenure discourages prudent use of grazing land; and intermingled ownership of private, county, state and federal land handicaps sound land management. Since the grass has been reduced or killed out on many ranges, over 300 million acres of United States grazing lands have been invaded by minor or major growths of mesquite, cedar, oak, sagebrush, myrtle, creosote bush, cactus and many other low value or worthless types of woody vegetation.

Livestock will live on some of these shrubs when forced to, but such plants are inferior substitutes for the original grasses, as their tissues are coarse and generally low in food value. Many of them grow out of reach of livestock when they mature. They provide poorer soil protection than grass and about twice or three times as much water is required to produce a pound of brush as grass.

Removal of undesirable woody vegetation is costly, seeding of grass after removal is often essential and expensive. Grass is extremely difficult to establish in dry regions. Cost of keeping woody vegetation in control afterwards calls for constant attention and expense. The soil Conservation Service estimates that 50 million acres of privately-owned grazing lands of America need to be seeded. The area of public land needing the same treatment is exceptionally large. It is probable that a large part of the ranges now having only 25 per cent to 30 per cent of their original productivity will have to be seeded to hasten recovery soon enough to be profitable to their present owners. The process of natural succession is too slow to wait for, under such conditions, as original climax plants are either dead or too few in number to provide a sufficient source of seed.

In the face of declining production on native range lands, operators have been forced to strenuous efforts to provide other forage supplies. The shortages have been partly met by feeding more farm roughages and commercial feeds to grazing animals. The use of commercial feed in Texas, for instance, increased about 400 per cent between 1906 and 1940. Hay acreage has been sharply increased since 1920 on some western range areas, and the average winter feeding period has increased as much as four to six weeks in some localities. These expedients have added considerably to operations costs, but have been the only means by which it has been possible to maintain livestock numbers in the face of a continuing downward trend in range condition.

RESEARCH PROBLEMS AND NEEDS

Range deterioration has a long start and if we are ever to overtake it, we must invade the situation with all of the force and vigor that we can muster. Application of a large amount of high quality conservation work on grazing land has been slowed down because action programs have not all the necessary information. Conservation will not be applied within reasonable time limits unless data needed in establishing principles for best use and development methods for all sections of grazing areas are made ready quickly for widespread use. Much basic information obtainable only from experiments and well-directed observational studies is necessary for furthering improved development and management of the grazing resource. Although fragmentary grazing studies have been under way for over forty years, there still is no comprehensive approach commensurate with the importance of national and regional grazing problems. *There needs to be a thinking-through of grazing research on the basis of resource restoration and needed improvements and changes in livestock-production economy.* Grazing land is a composite of miscellaneous resources which are continually being modified by unpredictable features of climate. Moreover, the dynamic character of grazing lands, especially in dry regions, does not readily lend itself to exact standards. Accordingly, such a large-scale research program calls for a carefully planned foundation. The foregoing by no means patronizes the attitude that we cannot attack the principles of conservation problems on grazing lands until findings of research are complete. There are numerous research problems that need to be solved. These have repeatedly been set forth in detail in numerous other documents, so only those which have national conservation significance are emphasized here.

1. *Artificial Seeding*

New concepts and innovations need to be added to viewpoints on research in artificial seeding of land seriously depleted by grazing, abandoned farm land and farm land that is to be planted to perennial forage plants in a crop rotation.

a. Seeding of land provides an opportunity to introduce forage plants that will furnish green feed at times when natives are dormant or low in feeding value. (Most of our livestock spend half of their life gaining back in the growing season flesh they lost on low quality forage in the dormant season.)

b. Widespread seeding trials should be undertaken on areas where native pastures and ranges have degenerated so far that natural succession cannot be depended upon to return them to top production soon enough. Such seeding trials would include planting on rundown grasslands where seedbed preparation may be too expensive and often impossible. Seeding by airplane should be perfected. Rodents and insects preclude successful seeding of many denuded grazing lands and means of overcoming this hazard need special study.

2. *Study needs to be given to value of natural plant litter or mulches on grazing, especially as they affect:*
   a. Rate of infiltration, runoff, flood control.
   b. Evaporation from the soil.
   c. Soil temperature.
   d. Activities of beneficial or detrimental soil life.
   e. Forage production.
   f. Crusting, sealing tendencies of soil.
   g. Raindrop splash, soil detachment and transportation.
3. *Emphasis needs to be given to selection and perfection of high-producing regional strains of forage plants.* More needs to be done toward domestication of native species for special grazing and conservation needs.
4. *The value of various conservation plants from the following standpoints needs to be studied:*
   a. Durability under different intensities of use.
   b. Resistance to drought and disease.
   c. Value in production of litter or mulch.

d. Ability to produce abundant and deep root system.
e. Feeding value and yield.

5. *Grazing lands probably present the field of biology one of its greatest opportunities for service.* The coactions of wildlife, insects, rodents and microscopic life on the grazing lands are too little understood for us to know how far this important science can be of aid. Studies of their interactions on grazing land need to be evaluated.

DIFFUSION OF KNOWLEDGE ON GRAZING

Restoration and improvement of grasslands is largely dependent upon widespread distribution of current knowledge of grass to both landowners and to those who are teaching agriculture. Teachers of agriculture and action agency personnel must be able to identify the important native and domesticated plants before they can evaluate their reactions to grazing, competition, drought, wildlife and insects. The landowner must be able to comprehend the same things before he can become a conservation farmer or rancher. Professional agriculturists must first gain an adequate knowledge of grass before they can be of assistance in the widespread diffusion of grassland information.

Much of the important data on grazing is written in highly technical language which most landowners and agricultural teachers cannot understand. Useful parts of such data should be interpreted for wide use. Imperfection of devices for diffusion of useful knowledge on grazing to landowners is largely responsible for the present condition of United States grazing lands.

For a long time a few people have understood the growing habits of plants and requirements of grassland agriculture. Even some of the patriarchs of Genesis knew the basic principles of sound grassland management. Archives in the country are piled high with mouldering volumes of experimental data and eventual experience on the use and preservation of grassland. The major knowledge on grass in the country is held by specialists in three government agencies and the agricultural colleges of the country. This knowledge is held by too few men, most of whom do not contact the grass-using public. Too little of this mass of piled up information has been converted into useful forms for public consumption and communicated to livestock growers in such a way as to stimulate them into constructive action. Generally, the facts have been fired from long distance with too little personal contact between the men who know grass and those who use it.

The kind of information needed is evident and the need for well-directed action is positive. The problem will not be solved by brilliant invention, but will be aided with more universal knowledge and understanding of elemental principles of botany, ecology and artful grazing management as tools for action. These must be conveyed in common language to the grass-using public.

PHILOSOPHY OF GRASS

We need to develop a sound national philosophy about grass. Grazing lands have been given no considerate attention because there have been no national traditions for grass. There has been no common language developed for it like there has been for cattle, sheep, corn and cereals. The history, lore and traditions have developed around the plow, the rivers, pioneers and cowboys. In our national settlement program, arable grassland was held in sort of escrow pending the arrival of the breaking plow. Land unsuitable to the plow was regarded as waste-land.

Grass has been entered but little into the national mind, history or lore. The same is true for the world, for that matter. The Bible, being a record of ancient pastoralists, contains a number of prophetic references on grass but, like in most books, the mention of livestock is far more prevalent, there being over a hundred on cattle alone. American literature dwells pitiably little on grass. However, the few writings on the subject are excellent—such as William Cullen Bryant's "The Prairie," John Ingall's poignant lines on "Grass," and Willa Cather's words on the wine-stained bluestem

grasses of Nebraska in her book, "My Antonia."

Struthers Burt has written a most illuminating statement on grass in his opening paragraph in "Powder River—Let 'er Buck." Here is the way it reads: "This story . . . is in reality—the story of grass. The search for it. The fight for it. The slow disappearance of it. Grass, that strange green thing which covers the earth and without which man cannot live, and the color of which, the secret of life itself, is still as much of a mystery to man as when he first saw it."

NEED FOR ACTION

The time is overdue for universal appreciation by landowners, public institutions and action agencies of the size of the problem, of the urgency of the situation, and the broad opportunities for service to American agriculture, and national welfare through united action to build up and improve the grazing land.

Improvement of grazing land is a hopeful and rewarding activity. In conservation principles are applied to grazing lands, if grasslands are all stocked correctly, those lands needing it reclaimed and seeded and fertilized, animal products and net income would not be decreased, but would even be greater in many cases. The soil has undergone considerable damage but has been completely eroded only on localized ranges and pastures. Over half the grazing lands have enough climax of desirable introduced plants to seed the land, provided grazing is adjusted to allow natural revegetation. Areas of high rainfall will usually improve faster than drier ones.

The reward for practicing sound range conservation has been told by Raymond Pfluger, cooperator on the Concho Soil Conservation District, Eden, Texas. He stated that in 1937 when he began management of his ranch, he produced 21,000 pounds of wool, an average of 8.6 pounds per sheep; 69,000 pounds of lamb at 60 pounds per lamb; and 39,000 pounds of calves.

"This looked so easy," Pfluger said, "that I decided I would increase my wool clip to 25,000 pounds; so I increased my units to 83 per section. This worked fine for several years. In 1939 I added goats and by 1942 I had the ranch stocked at the rate of 90 animal units per section. This was the year I noticed a big change —I sheared only 16,000 pounds of wool, an average of 6.7 per sheep, and I produced only 36,000 pounds of lamb, an average of 51 pounds. It was then that I decided that a ranch has a limit as to its production of wool, lambs, mohair and calves. I have cut my units about one-fourth and have my sheep shearing 8.5 pounds, the lambs weighing 61 pounds, and the calves 460. My calf and lamb crops are higher, I buy feed for only bucks and bulls, and my death loss and breeding cost are less. Before 1946, I used about 50 tons of feed; this year it was only 10 tons."

Restoration and improvement of grazing resources comes about through proper relationship between numbers of livestock and annual forage production. Yearly forage yield cannot be regarded in terms of straight line production. It wavers with the annual variations in temperature, rainfall and other features of the habitat. Thus numbers of animals must fluctuate in line with seasonal forage production. It is futile to try to improve the grazing resource through the various grazing systems, season of use and by extensive water development, contour treatment, renovation, fertilizing, mowing, water spreading, fencing and seeding, unless livestock are kept in balance with animal forage production.

We have tried to invoke the miracle of the loaves and fishes on the grassland by running two or three or four animals where the grass could support only one. The degree of failure has been indicated. We need to know how grass grows so that we can graze it wisely. Trees, browse plants and forbs grow from the tip. But grass shoots forth from the bud or meristem in the crown. These facts are common knowledge to a few men but the time is long overdue for grazers to have the information so that they will understand the peculiarities of individual grasses as well as they do individual animals.

Helping bring about the latter should be the goal of the Soil Conservation Society of America.

Forests in Soil and Water Conservation

E. N. MUNNS

MR. MUNNS is Principal Silviculturist in Charge, Division Forest Influences, Forest Service, USDA, Washington, D. C. This paper, presented on the technical panel at the First Annual Meeting of the Soil Conservation Society of America, points out some of the benefits resulting from forest cover in the conservation of soil and water.

FORESTS HAVE PLAYED a large and important role in the conservation movement. According to the late Governor Gifford Pinchot, the term "conservation" as now applied to the several movements for the wise use of our natural resources, had its origin among the foresters of Burma, where the officials of the Forest Service were known as "conservators." Pinchot, in dramatizing the early forestry program, called it "Forest Conservation."

Thus forestry in the early development of the conservation movement in America became practically synonymous with it. Later, conservation was applied to the conservation of other resources. And it is now only 18 years since foresters first advocated legislation for the conservation of soil—primarily on the non-forest lands. Those specializing in flood control will be interested to know that the need for this legislation grew out of the study we made of the causes of the 1927 flood in the Mississippi River.

It is particularly fitting therefore, that this first annual meeting of the Soil Conservation Society give recognition to the part forests play in soil and water conservation. It is our purpose here to discuss some of the more recent technical findings in this field. These are important in many ways. They not only support the contentions of many early-day foresters but also point out new paths for future foresters to follow in managing lands in the interest of the soil and water resources. However, rather than reciting research results or presenting figures, we shall instead outline several principles. Some of these may appear trite to conservationists, but if so, they are mentioned in order to emphasize their importance. We shall also present a few hypotheses some of which are as yet unproven. In so doing we are calling attention to the need of more thought and study by all those interested in the conservation of soil and water.

Relation Between Forests and Water

Forests affect water in many ways. In so doing they may be beneficial, neutral or deleterious. Forests are beneficial when they operate in such manner as to conserve supplies, provide high quality water, make more water available, retard flood flows, increase ground water, maintain summer flow, and provide good fishing. They are deleterious when they cause floods or waste supplies unnecessarily. Whether forests are beneficial or deleterious depends on the forest, where it is, what it is, and especially how it is managed. Consequently before one can determine whether the forest or the management is good or bad, one must know something about the relations between forests and water.

The relations between forests and water are close. They are simple yet can be complex. They vary with the season, topography, soil, and climate. They vary with the type and character of the forest. They also vary with time. Let us look at some of the more pertinent of these relations.

1. Forests do not greatly affect precipitation. There is some evidence that by clearing forest land over a large area, the exposure of soil has resulted in changes in precipitation that cannot now be satisfactorily explained. Be that as it may, the effect of forests on the total quantity of available water is here dismissed as relatively unimportant except in those few places where fog condensation is significant.

2. Forests use water. Trees need water for growth. The various species differ markedly in their requirements. Some species with abun-

dant water available may use 30 to 60 inches of water a year, whereas others in drier situations may use as little as six inches. More water is used by some trees during the 6-week period of maximum growth than in a 6-month dormant period. One forest type uses about 6 inches of water in a single month in late spring.

3. Forests intercept precipitation. When frequently wetted in full leaf, hardwoods cause many times the water loss they do when the branches are bare. Conifers catch and hold more snow than hardwoods and may prevent a surprising amount of water from reaching the ground. Interception losses may be as much as 6 inches in a single year, and under some conditions may be more.

4. Forests reduce evaporation. A forest covered soil evaporates much less water than a bare soil and there is some evidence that the annual evaporation loss from a bare soil may in some situations be about as great as the amount transpired by the natural cover during the year. In addition, by reducing evaporation from snow accumulated on the ground, forests conserve an appreciable amount of water that eventually will melt and enter the soil.

5. Forests protect the soil. Tree crowns and the litter on the ground reduce the force with which rain strikes the ground and so prevent the surface soil particles from being compacted or shunted around by raindrop energy and splash. Further, forest soils are so anchored in place by roots that relatively little soil displacement takes place from any surface run-off.

6. Forests enrich soil. Tree roots forage through the soil for many essential chemical elements that are returned to the surface soil when the leaves fall. The decomposition of the leaves also aids the soil physically. And, as chemical and physical conditions improve, biological conditions also improve. With these improvements come also greater infiltration and greater storage.

7. Forests retard radiation. This makes for a warmer soil during the winter and for a less solidly frozen soil mass. Consequently when field and pasture soils are frozen so solidly as to preclude infiltration, the forest soil is open and receptive.

With these relations established, the forester is ready to manage his woods in the interest of the water resource. What he does is therefore also conditioned by the major use or purpose to be served. One could enumerate such purposes as domestic water supply, irrigation, and flood control. And, these purposes might be further modified according to whether the water was stored behind a dam, allowed to flow in a stream, or stored in an underground reservoir. Again what the forester does would depend on the geology, on whether the soil was deep or shallow, whether the topography was steep or gentle, whether snow or rain was the important feature, and whether the area was in public or private ownership.

RELATING WOODLAND MANAGEMENT TO WATER RESOURCES

The question is often asked: Actually, is it possible to apply such knowledge of forests and water relations to woodland management in order to meet some of the public interest in the water resource? The answer must be in the affirmative. We know that we can so manage forests as materially to affect both the yield of water, and the rate and character of its delivery. Let us briefly indicate how management can affect water resource.

The yield of water from forest areas can be increased by cutting. In cold regions where such conifers as spruce predominate, removal of the heavy branching trees is suggested. Their removal will not only reduce transpiration, but will also permit the snow that otherwise would be evaporated from their crowns, to reach the earth. On the ground, this snow would be shaded from sun and protected from wind, hence most of the water in it would be available for run-off. Various types of cuttings are suggested such as individual tree selection; cutting in narrow strips at right angles to the spring winds; or clear cutting in small blocks whose diameter would be about equal to the height of

the trees. The substitution of aspen for spruce is also suggested. Aspen, leafless in winter, permits virtually all snow to reach the ground whereas much snow is retained by spruce crowns. Furthermore, aspen provides minimum interception for late fall and early spring rains whereas spruce interception and evaporation is high. Aspen builds soil better than conifers so aids in infiltration and in storage.

In conifer forests where snow is not a factor, water yield can be increased by maintaining a uniformly rather light forest stand over the area. Care must be taken however that an ample litter cover is present at all times. Where hardwoods will form an understory, they should be encouraged so as to provide a mixed hardwood and pine litter. Such litter aids in maintaining good soil conditions and the health of the stand.

In areas where deciduous trees predominate, a change in management from the high or commercial timber type to a low or sprout forest will be attended by the release of added supplies of water. Savings in water yield will result from a reduction in transpiration and to some extent from reduced interception. In such instances, clear cutting is permissible provided either sprouts or other regeneration takes place immediately. If a compromise is necessary so as to provide adequately for the production of both timber and water, repeated cutting of the riparian vegetation will provide a material increase in water yield.

In open areas, such as in high mountain parklands, the planting of snow traps will make for greater water yield as they will provide for the accumulation of snow and its protection against evaporation. Such barriers should normally be of mixed conifers and hardwoods. They should be planted densely in rows at right angles to the prevailing winter winds so as to catch and hold snow in drifts instead of permitting it to be lost through sublimation. Such barriers, especially in areas of deep soil or over source areas of underground water, would assist in providing increased water supplies.

Usually, when maximum supplies of water are required as for domestic supply or irrigation, surplus water is to be caught and held in a reservoir until needed. In such cases, maximum water yields are required and the treatment is more or less as outlined. However in some small watersheds and possibly in large ones, water may be exceedingly precious because of its insufficiency. Here it may even be desirable to substitute grass or shrubs for trees. This may be heresy from a forester, but there is a catch to it. Such a change would only be desirable when there is absolute assurance that the quality of the water caught in the reservoir would not be adversely affected. If the change resulted in a form of use that brought about erosion or that resulted in erosion even without use, then the change should not be made. As conservationists interested in the public welfare, we must never lose sight of the fact that a reservoir is a precious non-renewable natural resource. When the reservoir has been filled even though according to dollar economics of today it may have paid for itself, the country has lost an irreplaceable resource.

There are other ways too of increasing yield through saving water. In some parts of the West, water seldom flows on the surface. Instead it moves through deep deposits of coarse material of rock and gravel that we know as the river "wash." Often these washes are claimed by trees of various kinds, trees that rarely furnish anything but fire wood. In such areas, these woodland mavericks use a tremendous amount of water. Under some circumstances as much as 5 acre feet of water a year are lost per acre from such woodlands. Cutting these back can save about that much water.

WATER CAN BE DECREASED

The yield of water from forest areas can also be decreased. To accomplish this, a reverse of the processes just described is necessary. Where flood control is the objective, then the forester must strive to bring about the maximum of water loss. In the snow country, he would

(Continued on page 56)

Soil Conservation in Our Democracy

H. C. BYRD

DR. BYRD, President of the University of Maryland, delivered the following paper at the first annual meeting of the Soil Conservation Society of America. His thinking and leadership has contributed greatly to the development of Maryland's conservation and agricultural program.

MY GRANDFATHER was a sea captain. My first thought about soil conservation came when, strolling along the river shore one day, he pointed out to me where, when he was a boy, his father had anchored his ship. The water was hardly deep enough to push a small flat-bottomed skiff. Then he pointed out a place far out in the water where he said a house used to stand, where fig trees had grown in the yard, behind which in the evenings he had spent his time at home hugging a good-looking girl, who later, it happened, became my grandmother.

In a boyish way, I wondered where the land that once had been there had gone, and what had become of the deep water where ships had anchored.

Recently, in driving an automobile across the United States, I saw, along the Mississippi, the Missouri, and the Platte, and in many other places, recent and more serious evidence of the ravages of erosion.

In the light of what modern day science has taught us about values that lie in the soil, it would seem that we can give new meaning to the words of Genesis, which give man his beginning out of the soil. When we consider that our very existence depends upon the minerals that plants draw from the land; when we know that we must give back to the soil those values that are taken from the soil by plants and consumed by us, something of a new meaning may be read into the words, "For out of it thou wast taken, and dust thou art and into dust shalt thou return."

It is not my purpose to talk largely about the values in our soil. You, perhaps, know far better than I that soil gives to the plants that grow in it only those food values that the soil itself contains. Nothing could be more wrong than for some of our nutritionists to say, "Drink a pint of milk, eat an egg, eat some fruit, eat some green vegetables and you need never worry about your health." There is no particular apparatus in a cow's biological machinery, for instance, to produce phosphorus and calcium in her milk, unless that phosphorus and calcium was in the hay or pasturage or other feed. Copper, iron, cobalt, magnesium, potassium, silver, sulphur, and other minerals that our body requires will come to us through the plants we eat only if they are contained in the soil in which the plants grew.

Course of History Is Affected

It is difficult even to conjecture the extent to which soil depletion, in other words a lack of soil conservation, has affected the course of history. It would take a tremendous amount of research to determine the numbers of people who have migrated from one part of the earth to another in search of land rich enough to sustain their lives. We know that nearly 2,000 years ago, under Rome, there were certain sections of what is now Italy in which birth rates declined in the rural districts to such an extent that bounties were offered for every child that was born. It is believed that these birth rates declined largely because of soil depletion, which took from plants the procreative elements

which are necessary to propagation of the human species.

The northern shores of the Mediterranean could no longer support their populations satisfactorily after the Romans had denuded the forests; and, to this day, I understand the shore lands of Yugoslavia are almost barren because no system of cultivation has been devised to prevent rains constantly washing away the topsoil. Canaan was no longer a land of milk and honey when the forests were destroyed and the subsequent irrigation systems failed.

It was not without basic reason that Cicero uttered his famous, "Delendo est Carthago." Carthage then was the center of the richest wheat growing section in the world. Roman soils had been depleted and Carthage was the granary that furnished Rome and Southern Europe with its bread. And recently, in all probability, this was the chief reason why Italian and German eyes were cast in that direction. The top soil of Tunisia was the objective in the last war just as much as it was when Rome and Carthage fought; and, while, in this world of problems and difficulties, it is not safe to make many predictions, I would not hesitate to indicate that Great Britain, in one way or another, will retain her present hold on that same territory and for the same reasons. Who holds the lands of Tunisia will come close to feeding the hungry mouths of Europe. Not only are the lands of Tunisia a source of power, but they are also a source of profit.

As God commanded in Genesis, the earth brought forth "grass—the herb yielding seed, and the fruit tree yielding fruit after his kind, whose seed is in itself," causing plants thus to perpetuate themselves; but these plants will not bring forth any more in the way of food values, so far as minerals are concerned, than the soil itself contains.

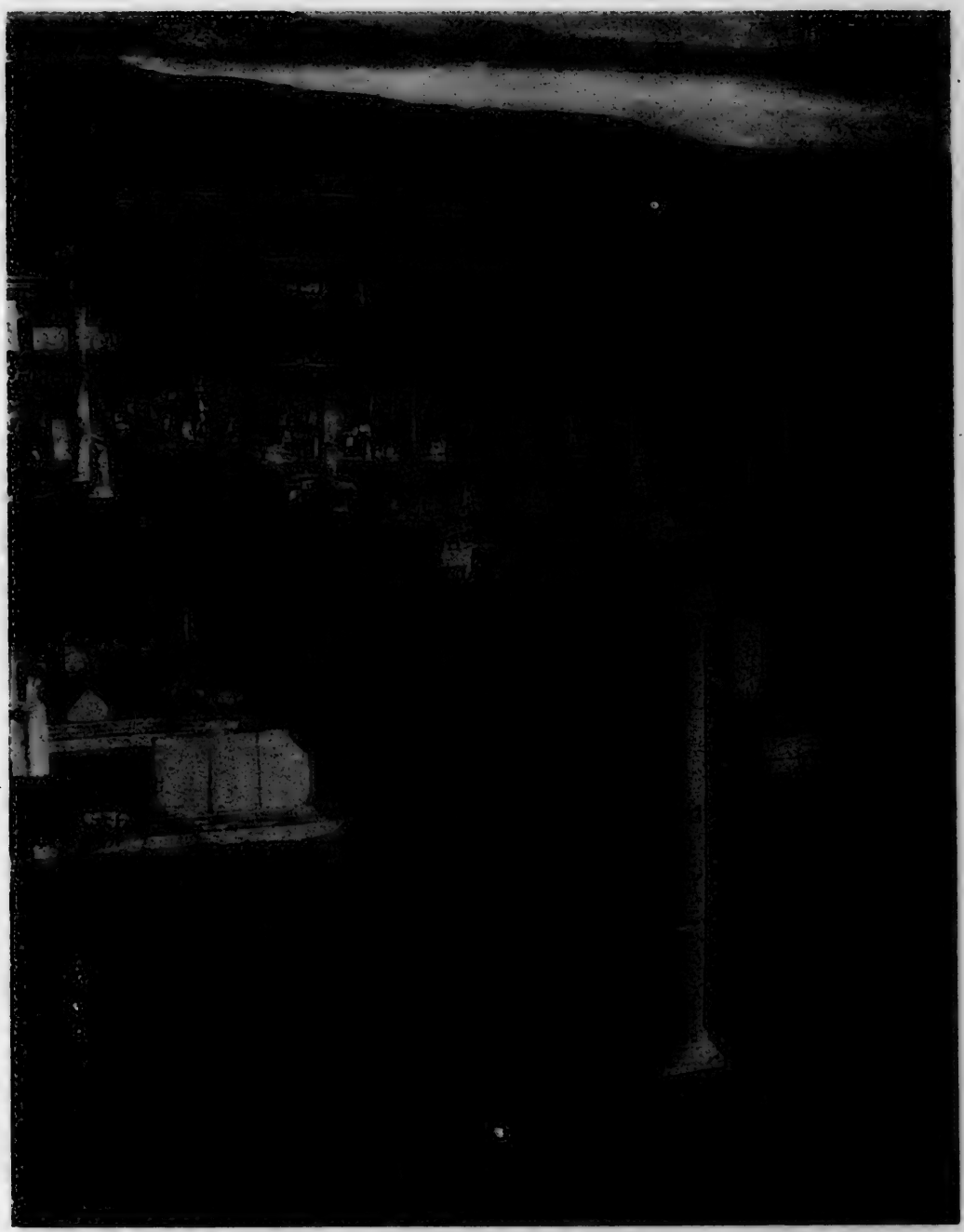
In our diets we may get the fats and all that is necessary to make us seem to be in good health, but if we accept the thesis that plants, because they are of a certain variety, contain all that is necessary of certain food values, which actually they do not contain because these values were not in the soil in which the plants grew, we are probably missing some of the elements, the absence of which create diseases and destroy health.

It is impossible for us to say definitely that the great percentage of rejections due to physical inability in the second World War, as compared to the first, were due to depletion of food elements in our soils, but it would be extremely difficult to find any other reason that would be responsible for such a nation-wide and general condition.

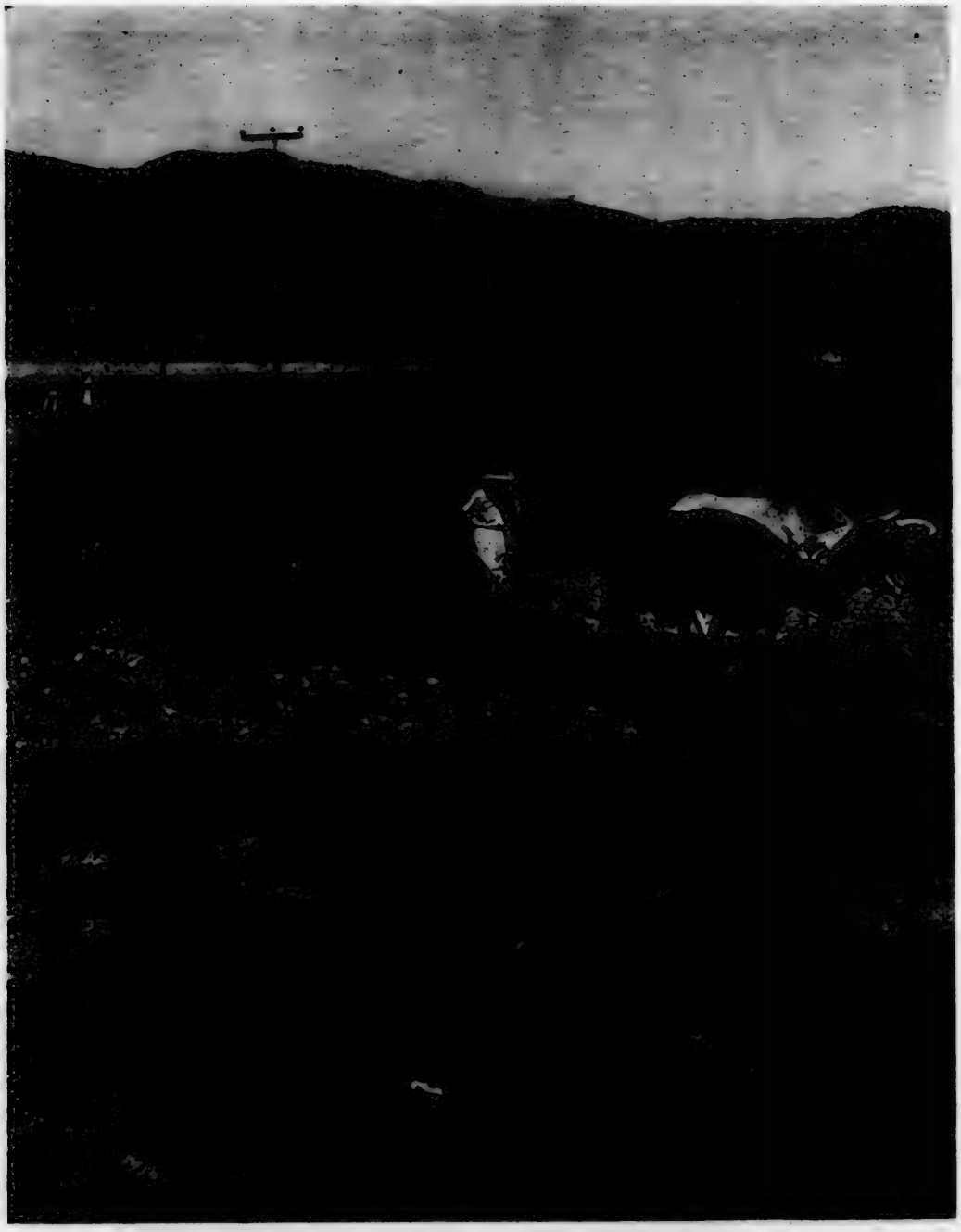
It is not necessary to talk about soil depletion in relation to our farm income. We know that a rich and fertile soil means an income for our farm people which will raise their standard of living and which will create a buying picture in agriculture which is the basis of our national economy. It is true that when agriculture is prosperous, the nation is prosperous; because agriculture furnishes such a large percentage of the basic raw materials on which our industries depend. Fertile soil means prosperous farms and prosperous farms means a prosperous and sound nation. And, to carry this a little further, it is likely that a prosperous nation means a sound government.

SOIL EROSION CONCERNS CITIES

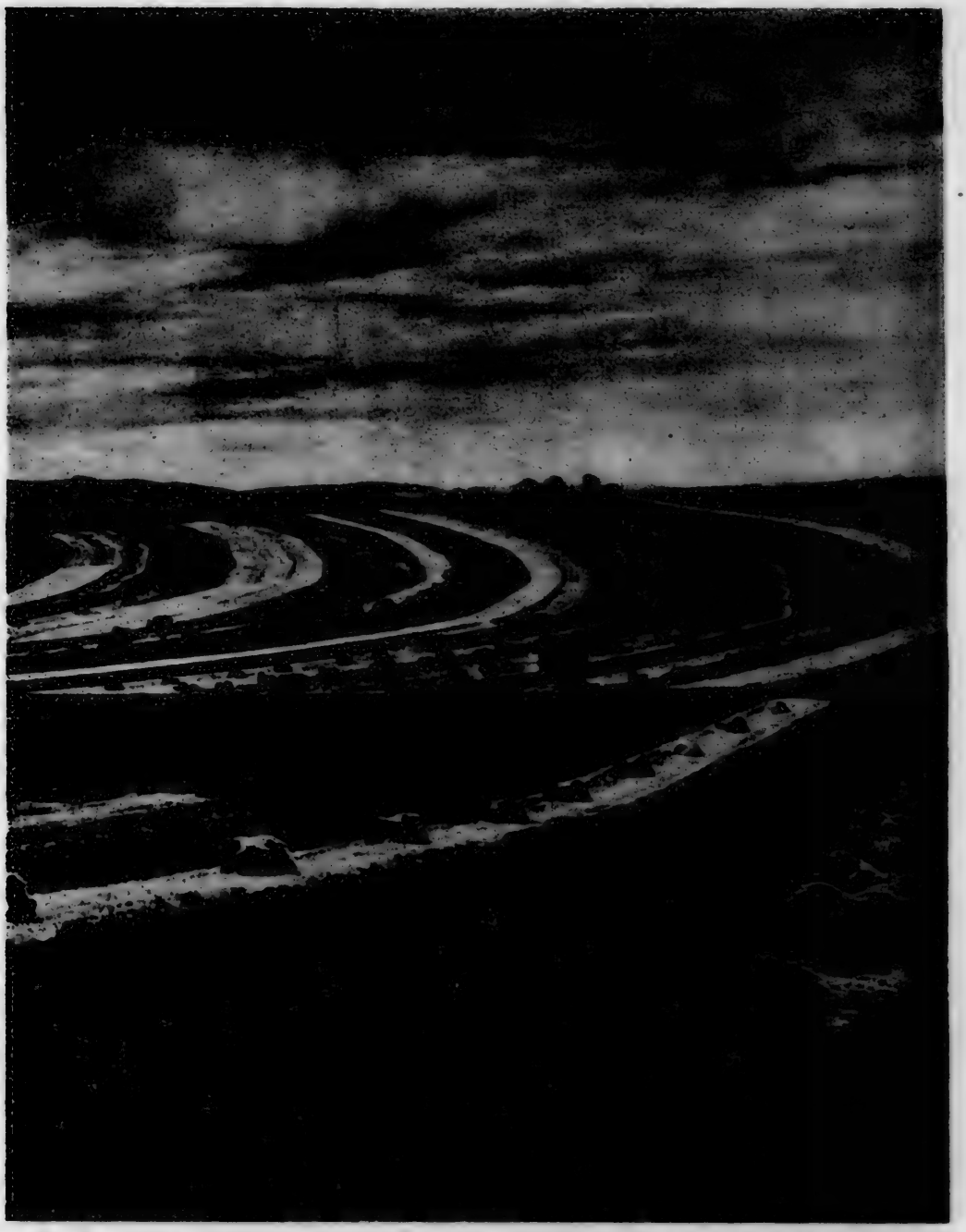
But, say some, the conditions on the farms and the matter of depletion and loss of soil is something for the farmer to worry about and not for the cities. Well, Dr. Hugh Bennett not long ago made a speech before the Kiwanis Club of Baltimore in which he produced facts and figures which indicate the extent to which the cities, particularly our seaports, are, or should be, interested in soil conservation. Dr. Bennett astonished Baltimoreans by some of the figures that he used to show Baltimore's financial interest in this work. In the small Balti-



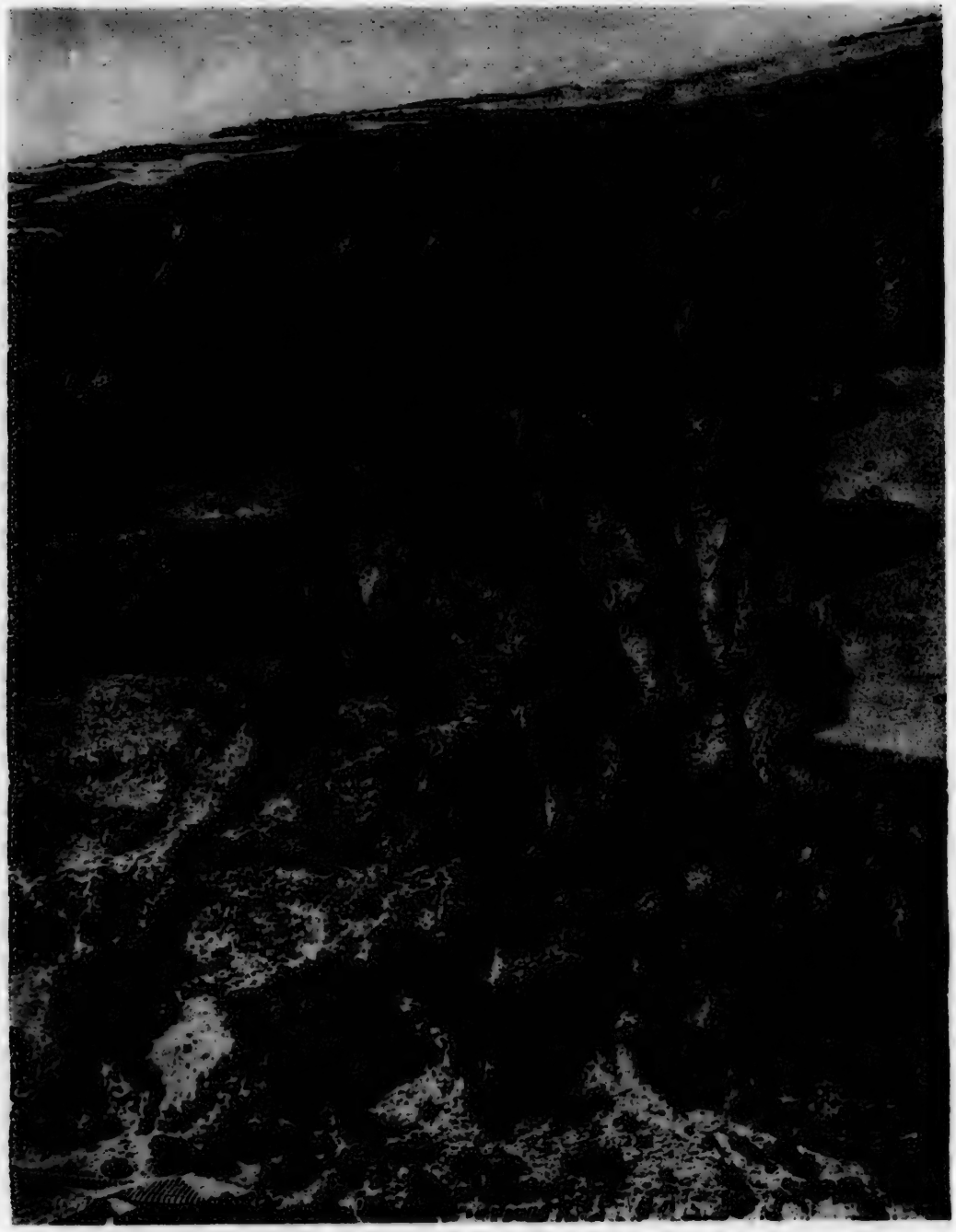
The glory that once was Rome—Timgad in North Africa. Deserted long ago, the city was buried for 1,200 years by erosion debris from surrounding lands that once supported Timgad's 25,000 people.



On fertile irrigated bottomland at Maracay, Venezuela, 60 miles west of Caracas, oxen are used to demonstrate modern methods of soil and water conservation, such as contour cultivation.



Variegated pattern of contour strips illustrates use of the land that has become traditional with farmers in Germany. When families live for generations on the land they come to love it and learn to care for it.



Irreparable damage caused by a hundred years' cultivation for wheat, still grown on the 46 per cent slope on the right. The area was forested in the seventeenth century, according to early missionaries.

more harbor alone, the channels have been kept open only at a cost of $17,000,000 spent by the Federal Government, in addition to the millions that have been spent by private concerns and by the city itself. Probably 200,000,000 cubic yards of sediment have been removed from the Baltimore harbor, and this sediment was largely top soil that came from Maryland farms. In other words, Maryland farms thus lose their productivity, and to remove this silt from the harbor costs millions of the taxpayers' money.

The natural question that arose in the minds of those Baltimore businessmen of the Kiwanis Club was, "Why is it not a profitable thing to teach Maryland farmers to practice conservation on Maryland farms to prevent this waste of Maryland's top soil, and by so doing, preserve the economic worth of Maryland's farms and, in addition, prevent such large expenditures of money for dredging?" The same question and the same condition would be applicable to many other states and many other cities of America; in fact, to practically all of them.

It does not take any great mathematician to figure that, with profits at one end, and savings at the other, the soil conservation program would pay for itself and be profitable to everybody.

The welfare of every individual will in the future depend upon the productivity of the soil. We have been a profligate nation. We have depleted our natural mineral resources to such an extent that the end of most of them is in sight. Much of what we have in mineral resources we have been, and still are, giving away. All that we shall have left is our land. That land must furnish to us the food which means existence and health. It must furnish to us the fibers, the other varied products of one kind or another, out of which we shall manufacture our plastics, our clothing, and perhaps our medicines. Yes, man is so dependent on the land, the state of our nation so reliant on the soil, that it seems to me that the greatest basic problem that we face it to tie society to the land, to make our citizenship fully conscious of the real meaning of the words, "From dust thou art."

What are we doing about it, and what can be done? Well, we are doing a good deal. We can, and must, do more. In fact, we have got to do a good deal more.

We do not want, someday, archeological researchers, digging into the rubble of one of our ruined and long forgotten cities, to ponder over the results of the ignorance of a people who neglected their basic resource.

MARYLAND PASSED DISTRICTS ACT

When the State programs of soil conservation were first undertaken, I believe that the Soil Conservation Bill, written largely in the U. S. Department of Agriculture and introduced in the Maryland Legislature in 1937, was one of the first in the country. I shall never forget the words of my friend, O. C. Bruce, who came to me and said, "This bill has been introduced, but it will only go through if you take hold and guide it." Well, I thought at the time that any bill on soil conservation ought to have easy sailing. However, toward the end of the session, the Chairman of the Finance Committee of the Senate sent for me and, taking this bill out of his desk, said, "What kind of a thing is this anyway? Is this yours? Why, it sets up local governments within the county governments and extends powers beyond anything that the State ever has extended to groups of people in this State. I think we ought to kill it." My reply to him was this, "Would you deny the right of our people in different sections of the State to organize themselves into groups for their own betterment, with the main objective of protecting the basic economic resource of the State? If so, you deny to them the very elements of democratic procedure."

The bill passed, and shortly after the session,

went to the Governor for his signature. The lawyers advising the Governor indicated to him that the bill was too far-reaching and should be vetoed. Our people interested in soil conservation asked for a hearing. At the hearing, the lawyers who were present advised the Governor strongly against signing the bill, their reason being that it was too far-reaching in its provisions, that it set up governments within governments, etc. The Governor then turned to me and said bluntly, "What do you know about this and what do you want to say about it?" Joshingly, because those lawyers were my personal friends, I said, "Well, Governor, I don't wonder that the lawyers are opposed to this and say it should not be signed, because about all that most of these lawyers know about our economic life is to try to keep some of us out of jail when we go wrong, and they don't always succeed in doing that." Then, seriously, I said, "It is useless to try to go into all the merits of this bill this afternoon. There isn't time. But every law is just as good as its administration and I pledge you that if you sign this bill you will be doing the biggest single thing that any man has ever done for agriculture in Maryland, and I will pledge you that it shall be administered in such a way as to be a credit to you and to your administration." The Governor signed the bill and it became the soil conservation law of Maryland. Today the districts organized under that law cover almost the entire State. There is no other work in the State which has occasioned so much generally favorable comment. Soil conservation in Maryland has come to stay. We are on our way to great and abiding developments in the protection of our land, to the ultimate profit of our entire citizenship.

DEPLETION OF LANDS MUST CEASE

So apparent is the need for soil conservation that I wonder that all our people do not "get up on their hind legs," to use a colloquial Eastern Shore of Maryland expression, and demand that depletion of our lands cease and that methods be employed everywhere to preserve the fertility of the land. If our nation's prosperity, and consequently sound Government, depend on the land, you may be certain that, if our soil resources be depleted to a point where they are unable to support our people in health and profitably, the end of democracy in America will be at hand. If we are going to save our democracy, if we are going to preserve the integrity of our representative kind of government, it must be done by conserving our basic resource, the soil. The welfare of our people, the stability of our government, and the conservation of our soil are so irrevocably bound together that if the base of the structure, the soil, fails, the whole structure will fall.

It is not far fetched to consider that we shall have more people than our land can feed. I am told that the awful poverty of Japan and China today rests upon this factor. Recently, I had a letter from my daughter in which was the following sentence: "Until the ship docked at Japan and put garbage cans over the side and I saw hundreds of people literally fight to get at those garbage cans for food, I never knew what poverty meant."

China, I understand, has starving millions, entirely because such a small proportion of its lands are under cultivation. Japan reached out for more land in order to feed its millions. Japan was thwarted, but it is inevitable that its millions must be fed, because when people are starving, they will do anything for food.

We do not want depleted lands in this nation to develop such a condition here, and we want our government to continue in its present form. No nation, no people, ever flourished since the beginning of recorded history after food and vital necessities began to disappear. Then it is that those who control foodstuffs and distribution become rulers. If that time comes, our people will no longer be free. Russia calls it Communism, Italy called it Fascism,

Germany called it Nazism. We may call it regimentation. But whatever it may be, if that condition comes to pass, it will not be democracy as we understand it.

You agree with me, I know, that we do not want our soil resources to vanish, whether it be through over-cultivation, through failure to return to the soil minerals which plants take from the soil, or whether it be through soil erosion, or any other reason. We cannot countenance depletion of our soil unless, at the same time, we countenance the destruction of those factors that are basic in our national life. We cannot maintain our high living standards if our productive lands are allowed to disappear, while, at the same time, our people become more numerous.

We are making, through public health measures and medical research, every possible effort to advance the length of our lives. I doubt if our democratic government would tolerate measures to decrease or limit population. The only sure way to safeguard our situation as a people and as a nation is to safeguard our soil.

JOB AHEAD IS BIG

The Soil Conservation Society of America is a new organization, but no organization ever started in a field in which the possibilities of achievement were greater. I believe that we are laying the right foundation for an enduring and vital program, but the task has hardly begun. Ahead lies a job of such magnitude that it is difficult even for us to grasp and particularly will it be hard for those who know little of the tie between the soil and the national economy.

A member of our Board of Regents once, in questioning the type of work that was being carried on, and in questioning me on the effectiveness of the work, took me to a farm on which various kinds of soil conservation demonstrations were being conducted. He said, "So much money has been spent here that it is more than the whole farm is worth," which was true, in all probability; but what that member of our Board failed to grasp was the effect of that demonstration when it began to be translated to actual practice on many, many farms. And so you, in carrying the gospel of soil protection into your communities, and into various parts of this country, will find many "Doubting Thomases." Let me entreat you, though, to carry that gospel just the same and let that gospel carry, as a basic fact, the word that problems of the land do not stop at farm, county or state borders, and that soil depletion, from erosion or from any other cause, affects us all, regardless of faith, race, creed, or political affiliations, irrespective of whether we be bankers, business men, professional men, or farmers.

In the beginning, many of us were slow to accept whole-heartedly a few fundamental truths. We did not learn easily the lesson that education alone would never get done the job of soil conservation. We had to learn that money must be spent for a demonstration program that would point the way. We had to find out for ourselves that isolated action in scattered areas could not be substituted for cooperative community action, if a community, state, and national problem were to be solved.

But through these tribulations, through the processes of learning by experience, in my opinion at least, soil conservation has at last found a permanent place in our community and national life. And in finding this permanent place, through the rigors of tough experience, the beginning of soil conservation work has produced the finest basic example of democratic action in the agricultural history of this nation, namely, an effective, coordinated program through the organization of soil conservation districts.

Having been somewhat instrumental in getting the Maryland Legislature to pass, and the Maryland Governor to sign, our soil conservation bill, which became the conservation law of Maryland, I should like to talk with you a few

minutes about how these districts have fitted soil conservation into our representative, or democratic, form of government.

DISTRICTS ARE DEMOCRATIC

As a starting point, we knew that if soil were to be conserved, the farms and the farm owners of America would have to be the basic instruments to be used for that purpose. In addition to this, we knew that, under our way of living, any effort to force farmers into soil conservation practice would be a violation of our democratic principles, and would be certain to fail. No farmer can be commanded or forced into anything. His native and sound intelligence, though, make him quick to discern intelligent and sound leadership. It was evident that if soil conservation efforts were to succeed under such premises, that it must be on a purely voluntary basis. A voluntary act meant cooperation under local government; that it, under local organization created by the people.

On such democratic principles was evolved, through the organization of the soil conservation district, the most far-reaching program that has ever taken place in our democracy; and the program is growing with remarkable rapidity. I know of nothing else in our agricultural history quite like it.

The soil conservation district is getting the job done in a thoroughly democratic way. Perhaps the most important reason is that the governing bodies of the districts, usually farmers themselves, *coordinate* the activities of local State, and Federal agencies, which cooperate, into a completely integrated program that eliminates duplication and overlapping. That function of coordination represents, to me, one of the truly great aspects of the soil conservation districts program. It has brought about a spirit of cooperation among organizations and agencies that in many instances had existed previously only on paper.

Let me carry that thought a little further. A soil conservation district comes into being only at the will of the people of a community. The first job is to prepare two highly important documents—a program, which spells out the job that *needs* to be done, and a work plan, which outlines *how* the job will be done. The latter plan—how the job is to be carried out—is where the coordinating function of the district begins, for it specifically names groups, organizations, and agencies, and the assistance each has agreed to provide.

Think about the significance of this kind of cooperation. Here is a group, duly organized by a democratic process under a State law, which says, in effect: "Here is the job; here is what the Extension Service, the Soil Conservation Service, the Farm Bureau, the Grange, the County Commissioners, the State Forestry Department, the schools, the civic clubs, the highway department, the garden clubs, the sportsmen's clubs—and so on—are going to do to help us get the job done.

Such action represents democracy in fullest flower. It represents a spirit of cooperation that has evolved through common interest in the soil.

We must not permit ourselves to be satisfied with the progress soil conservation has made. True, we have come a long way, but the major part of the tremendous task lies ahead. We must think about ways and means of doing the job faster and better.

CONSERVATION EDUCATION IS BASIC

Education in soil conservation can be the biggest help, or lack of it the worst barricade, on the road to complete understanding and adoption of methods to save our land. Let's admit that a big job has been done in conservation education, or else the tens of thousands of farmer-cooperators in the more than 1,700 soil conservation districts would never have become interested. In all of the states, however, there are other tens of thousands still to be convinced that they need soil conservation on their farms.

The educational job in districts already

formed, and in communities where districts should be organized, is primarily the task of the Extension Services of our Land Grant Universities. In many communities those hard-pressed and earnest men and women of the Extension Service have recognized the soil conservation district for what it is—a mechanism to get concerted action to conserve our basic resource—and have spared no effort to help organize districts and help them operate successfully. In other areas, we must admit, the job has not been done so well.

In general, though, our agricultural educators have done their jobs successfully. But we must intensify and speed up our educational processes so that conservation can be put into effect more rapidly and in broader areas. We are moving fast, but not fast enough. I believe education is the principal bottleneck. In that connection, I commend to you a splendid address on the need for conservation education by Dr. R. K. Bliss on the occasion of his retirement after many years of distinguished service as Extension Director at the Iowa State State College. Dr. Bliss understands the problem of conservation education as few people do. I am pleased to see his name on the program of this conference.

GOVERNMENT HAS A RESPONSIBILITY

Now may I say a word about what the States can do to help soil conservation in our democracy. I believe it is a State responsibility to provide financial aid. As I see it, the State legislatures can best contribute by providing funds for sorely needed heavy equipment, for the payment of necessary expenses of district governing bodies, for the printing of educational literature and the procurement of motion pictures and other educational materials the districts need. The State governments, I believe, should also give a clear mandate to all their agencies and departments to cooperate fully with the soil conservation districts.

I would like to see intensified activity on the part of the 48 state soil conservation committees, commissions, or boards that are set up under the various state laws. Here are groups that can provide greater guidance to district governing bodies, help them recognize and assume their responsibilities, serve as a medium for the exchange of information and methods, and be their articulate spokesman on legislation and other matters. At this point, let me observe that it is well that governing bodies of districts are forming State-wide associations, and that the State associations are coming together in a national organization. This, I think, is a fine thing for action under a democratic government. In unity there is strength and progress. Incidentally, what could be more inspiring than the selfless leadership of the more than 8,000 district supervisors or directors who labor at great personal sacrifice that their neighbors, their community, their State, and their nation may benefit.

FARM ORGANIZATIONS SUPPORT CONSERVATION

The Farm Bureau and the Grange in our State are whole-heartedly behind soil conservation work because their membership is made up of the people who know what is being done, and why. Recently a local Grange presented the following statement at the meeting of the National Grange:

"Soil conservation programs already have yielded returns far above the expenditures made for soil building practices, developing sound conservation methods, and establishing soil conservation districts. They should now be extended further to broad natural areas where it is beneficial to do so. As further progress is made with soil conservation as a national policy, the programs in their broadest applications should tend to become self-sustaining."

Besides this, the Maryland State Grange passed the following resolution:

"Having supported the inauguration of soil conservation work in the state and the passage of the Soil Districts Law in 1937, the State Grange wishes to commend our State authori-

ties and the University of Maryland, in cooperation with the U. S. Soil Conservation Service, for the splendid progress being made. We wish to commend the Board of Regents of the University and the Governor of the State for the increase in support of this work by the last state budget and urge that increased funds be made available in the future to assist soil conservation districts in the promotion of this important work. We also urge our representatives in Congress to provide adequately for the U. S. Soil Conservation Service and maintain its identity in the U. S. Department of Agriculture."

The State Farm Bureau also passed a similar resolution.

Big soil conservation rallies also have been held in the State, at which the work has been highly commended and plans made for future developments. Maryland is heart and soul with the soil conservation program, because, through its democratic procedures, the people of the State know and understand what it means.

NATIONAL CONSERVATION AGENCY NEEDED

Now I come to my final major observation concerning the acceleration of our program. Let me say first, and frankly, that we must have a continuing, aggressive national agency devoted exclusively to the problems of land conservation. We have that now in the Soil Conservation Service. The job is too vital, too complex, and too basic ever to become a sideline to another activity. We cannot permit the national job to be split into segments, or to be subordinated to a variety of other agricultural programs. Ever so often you hear rumblings from Washington that the Soil Conservation Service will be made a part of the Extension Service of the Land Grant Colleges. Or you hear that it will be put under the Production and Marketing Administration, or that it will be a part of the AAA or that some other administrative disposition will be made of it. Let us remember that the Soil Conservation Service is basic to our national welfare, is necessary to the social life of our people, and, consequently, is sufficiently important not to become a subsidiary part of any other service.

If work experience means anything, I can say to you that, in my opinion we have done a better job in Maryland than we would have done had the Soil Conservation Service been a part of our Extension Service; and I am certain that we have done a better job than we would if the Soil Conservation Service had been a part of any other unit of the Federal Department of Agriculture.

Personally and officially, I find myself in harmony with that great American whose booming voice for 30 years has preached the doctrine of soil conservation. The vision of this prophetic leader has culminated in a vigorous organization which has approached its tremendous task as few Government agencies have ever done—in a thoroughly democratic way through the local communities. I refer, of course, to Hugh Hammond Bennett. To Hugh Bennett our democracy owes a great debt—one that posterity will appreciate more fully than we. Hugh Bennett had a vision. The result of that vision will be more far reaching than any of us here today could possibly conceive. Half a century from now, this man's name will be written in history as one who foresaw the greatest need of his country and as one who had the courage to initiate the action which met that need.

No more cooperative agency of the Government ever existed than the Soil Conservation Service. Its research is coordinated with the States. Its technical assistance, without which we would have no national soil conservation program, is given exclusively through locally-organized, locally-controlled soil conservation districts—and then only at the invitation of the leaders of those districts. Yes, the contribution of the Soil Conservation Service has been magnificent. Soil conservation in our democ-

(Continued on page 55)

Soil Conservation in the World Ahead

HUGH H. BENNETT

DR. BENNETT, Founder of the Soil Conservation Society of America, presented the paper that follows at a dinner meeting of the Society in Chicago, December 12. He was introduced by Charles Brannon, Assistant Secretary, U. S. Department of Agriculture. Mr. Brannon, before presenting Dr. Bennett, briefly reviewed the work of the Founder leading to the creation of the Society.

SOIL CONSERVATION is one of the biggest of all the jobs confronting us. It is as large as the world; as important as anything that remains to be done. It is essential to life and vital to the future of civilization. These are the facts of the matter when you look at the problem as a whole and in true perspective.

Soil conservation is the only known way to protect the productive land of the world. This is the land we depend on for food and fiber, for trade, and for a great many of the most important raw materials of industry. This is the land—our productive land—that we must maintain at all costs. It is the land on which progress depends. It is the land we may also have to look to in order to produce supplemental fuel that we may have to count on if we run short of other sources.

Most important of all, it is the land without which we could not survive. At all times we must have, somewhere in the world, enough good land to produce enough food to feed the families of the world. That is the rock-bottom minimum. Failure to maintain such a minimum would lead us, with the utmost certainty, into the most serious kind of trouble; for good land is an utterly indispensable resource of man.

Actually, we are already in a race. The sides are already drawn. On the one side, we are faced with a steadily increasing population. Year after year, even during the war, the number of people on earth has grown larger. No one can say with authority where, or when, the growth will level off. On the other side, we can see our remaining area of productive land shrinking steadily before the onslaught of erosion.

Population and Land Are Related

These are the forces we must deal with. Regardless of what can or should be done about the matter of population, we can and must do something about erosion. No nation—or the world, for that matter—has too much fertile land. Neither the world nor any nation can afford to lose any more productive land. Too many nations have much too little now. In relation to world population, our total ability to produce food has already arrived precariously close to the danger line. In some countries the danger line was crossed long before World War II.

As scientists we must recognize that we have reached a point where the loss of productive land anywhere on the globe affects the people and the nations of every other part of the globe. Also, every acre which goes out of production means that, to some degree, the pressure is increased on the remaining good acres. If this understanding is not reached, and something done about it, those people having insufficient productive capacity will be consigned to a future of poverty and the discord that almost inavriably follows. And this is the stuff of which strife is born.

So every acre we protect against erosion in the United States is a step in the right direction, not only for our own individual and national interests, but in the larger terms of humanity.

Conservation Job Is World-wide

What I have attempted in this paper is to outline, in a very broad way, the urgency and the size of the soil conservation job ahead, for the world. It is a vital undertaking which can

be delayed too long—has been delayed too long. It is also a task worthy of much more serious thought by responsible officials of individual nations; and the United Nations, without further postponement.

A national magazine, a few weeks ago, called me a "gloomy soil-saver," a "prophet of doom." Maybe I have sounded that way at times. I must admit there have been periods during the past 25 or 30 years when I have felt pretty gloomy about our soil-saving situation. And you may know I'm not one to keep such feelings to myself. I have tried over the years, as honestly as I have known how, to tell as many people as possible what has been happening to the land. In the beginning I bore down pretty hard on the menace of soil erosion. I couldn't see any reason for hiding a fact which I understood full well as a grave national menace, especially behind a curtain of darkness conducive to complacency and inaction. Lately it has been a very real pleasure to report also on our excellent progress with soil conservation. Two decades ago, I must confess there seemed little hope of my ever seeing accomplished even a small fraction of what has been done today.

I have an idea that most of you here tonight have heard me before, perhaps several times. Most of you know the facts about the land. I am not going to repeat them. Instead, I am going to give you my opinions about the future of soil conservation.

JOB CAN BE DONE IN 20 YEARS

First, let me say it is my considered opinion that we are going straight ahead with the nation-wide job of protecting our agricultural lands from impoverishment or ruin by soil erosion. It is likely to take about 20 years full speed ahead to get the basic conservation measures applied to the land. After that is done, necessary maintenance and improvement work will be required, but this will be comparatively easy and cheap.

Twenty years is not a long time to apply the basic conservation measures to so vast an agricultural area as ours. Nor is it a long time when you remember that we must deal with the land damage which has developed over more than a century of unbridled erosion. As a matter of fact, the achievement of primary protection for our agricultural lands within such a period would be progress at a remarkably rapid rate. I think it can be done.

Second, I want to mention a practical matter of politics. A friend of soil conservation asked me, not so long ago, how the Republican victory in the recent Congressional elections would affect the soil conservation program. I imagine some of you have been wondering about the same thing. My answer is that the soil has no politics. Republicans and Democrats alike recognize this fact. The soil conservation program has been, and will continue to be, non-political. It is a well-known fact that members of the Republican party, in and out of Congress, are among the outstanding supporters of the soil conservation program and the Soil Conservation Service. The work of the Service has not even been controversial; it has been widely recognized as the most effective and practical, as well as the cheapest and most rewarding, program of land improvement and protection we have ever had in the country.

I have full confidence that the new Congress will give maximum cooperation when it comes to soil conservation—comes to saving a resource without which there can be no Congress, no vigorous Nation.

Furthermore, in connection with the nonpolitical nature of soil conservation, it should be noted that in soil conservation districts all across the country farmers who vote Republican and farmers who vote Democratic have joined forces, in a thoroughly non-partisan way, to achieve joint soil conservation objectives and halt the common enemy—soil erosion.

INTEREST IN LAND GROWING

Third, I believe it is important to mention the mental attitude of the people generally, for this has its effect on soil conservation. Today

there seems to be a great deal of doubt and concern about the future. People everywhere wonder what tomorrow will bring. They search for something solid and genuine they can count on. Many of the old slogans they once believed in have proven false. Few standards and values remain that are not subject to questioning, especially by the young men and women of our times. These are years of great change and no one can predict the outcome, except that it may be unlike anything we have ever known before.

Out of this frame of mind, a new interest in the land is growing by leaps and bounds. You can notice it on all sides. Men and women who would normally have little or no concern about such a matter as soil erosion are spending great amounts of time and energy to help blot it out. These are signs of the times. People are beginning to see in productive land something that is good and tangible. They have discovered that productive land, properly safeguarded against erosion, is something a man and his family can see, and feel, and count on, to a very great extent, through periods of trouble as well as in years of prosperity. Take care of the land and the land will take care of you, is a good way to look at it.

This idea extends beyond the farmer. Throughout our society there is developing a deeper respect and appreciation for productive land as a source of strength and wealth. Not only farmers, but business men in the cities and towns across the nation—manufacturers, merchants, those engaged in transportation, bankers, professional people—are putting their support and influence behind the job of real soil conservation. The same is true of educators and the church; of the newspapers, the broadcasters, and the magazines. Indeed, for a great many people, soil conservation has taken on the stature of a great national crusade and action program.

Back of it all, I believe, is the growing realization that productive land is one of the real foundations on which a people can build and prosper. I think this is part of a new American attitude toward life which is emerging out of the trials of the recent war, the great depression of the 30's, and the unprecedented mid-continental drought of the same period.

I hardly need add that men and women who recognize the true worth of productive land will not stand idly by and permit erosion to ruin it; these people will be soil conservationists.

DISTRICTS ARE A REAL FACTOR

Fourth on my list, though in many respects first in importance, is the unprecedented development of soil conservation districts. Brought into being by the votes of farmers and controlled by the farmers themselves, these districts have proven to be a popular and a powerful force for soil conservation. With the technical assistance of the Soil Conservation Service available to them, they are getting the job done effectively, scientifically, democratically, and by all reasonable standards, permanently.

Next year, some of the districts will celebrate their tenth anniversaries. While it may have escaped the attention of some, this audience should take particular note that soil conservation districts are now an established part of the American system of government—self-government. Their experimental days are over; they are a fast-maturing institution to be reckoned with. In the months and years ahead, you can count on them to make known their wishes with respect to soil conservation.

Two months from now, in this city, I am informed, the permanent organization of a National Association of Soil Conservation District Governing Bodies will be completed. This association, with direct lines of communication to the soil conservation districts of the country, is dedicated to the advancement of soil conservation through the spread of understanding and education. I am confident its work and influence will be felt.

FARMERS HAVE CONFIDENCE IN SERVICE

My *fifth* point concerns the Soil Conservation Service. And right at the outset, I want

to say publicly that I am 100 percent proud of the Service and the men and women who compose it. I am proud of their record during the war and I am proud of their record in getting soil conservation measures on the land in yearly increasing amount and of steadily good quality. They have stuck to their job and maintained a spirit of public service which I claim is not surpassed anywhere.

The Service has worked for and won the respect and confidence of the farmers. As a flat statement, I say the farmers like the way the Service works. They like the Service program, which is carried on cooperatively with the individual farmer, not indoors, but out in his own fields, pastures, woodlots, gullies, idle lands, where the job of conservation must be done. The steady, rapid growth and continued active cooperation of soil conservation districts with the Service all over the country is the clearest proof, as I see it, of the favorable farmer reception of our program.

Further, the Service has won the support and the confidence of citizens, organizations, and business concerns far from the farms. We have won it on the demonstrated basis of getting a necessary job done well, with frugal use of money, full regard for the rights and preferences of the individual, and a policy of productive cooperation and sticking to our knitting.

In short, the Service has the backing of the people of the country. We are proud of this support and aim to keep it by continuing to earn it. As the technical arm of the soil conservation program now moving ahead so splendidly in all parts of the nation, in cooperation with soil conservation districts, the support and confidence of the people is a factor of the utmost importance. It is a constant spur and stimulus, under friendly conditions, to greater effort, higher quality, and faster progress.

I can't resist telling a story here about an incident of several years ago. On very short notice one day I was called into the office of one of the top officials of the government. He was smiling when I got there, so when he asked me how I was feeling, I told him I was doing pretty well.

"Dr. Bennett," he said, "how is the Soil Conservation getting along?"

I told him I thought it was doing all right. Things weren't perfect, I added, but the job was getting ahead in good fashion.

"I thought so," he said. "The Service must be doing a really good job. Somebody else wants to absorb you. I've noticed something about the government. Every time an agency does an outstandingly good job, there's always a move by someone else to take it over. That seems to be the penalty of success."

It wasn't hard to agree. In retrospect, it seems that somebody has always been trying to take over or absorb the Soil Conservation Service. The attempts are still being made, but with each passing month I think they are less likely to succeed.

PROSPECTS FOR FUTURE LOOK GOOD

Getting back to my estimate of the immediate future for soil conservation work, however, I would summarize by saying the prospects look good. The major, important factors are favorable to a sustained, strengthened program in the years just ahead. Farmers are approving the program and speaking out for it. They are steadily organizing new soil conservation districts and are making established districts work in a manner that is most gratifying. Urban and educational interests of all kinds are staunch backers of the program. The indications are that Congress will continue its support and perhaps even strengthen it. And I know the Soil Conservation Service stands high in the regard of the people generally. They know that we have stuck to our job from the very beginning.

Tonight, you see, I cannot be called a "gloomy soil-saver."

Even though the future may look promising, I think it is scarcely necessary to remind you that now is not the time for soil conservationists to rest on any fancied laurels. Like liberty,

the price of opportunity is eternal vigilance. And eternal work. First and most important it is necessary to maintain and improve quality and keep up a good rate of progress. And there may always be a few who would like to wreck the program on one pretext or another; some, I am afraid, would like to take it over—even though they never knew anything about the erosion problem in the beginning and never at any time raised a hand to do a single thing to get the program underway.

During the next 20 years I look for the United States to make the greatest soil conservation effort that's ever been undertaken in history. I look for the United States to become the first major nation in the world to take the steps necessary for effectuating permanent protection of its irreplaceable soil resource. This is not just wishful thinking. It is based on my beliefs in the good business judgment of the people and the Congress of the nation.

COST OF INACTION WOULD BE GREAT

Consider this: The cost of *not* going ahead with a scientific, acre-by-acre, soil conservation program during the next 20 years, as we have planned, would probably amount to not less than $20,000,000,000. That means the cost of inaction would average out at around a billion dollars a year. This is the minimum price we would pay for *not* doing the job, as well as can be estimated. The chances are the bill would run higher. It would be levied against us in terms of reduced yields, lost plant food, and reduced productive capacity, increased flood damage, increased damage to highways and railroads, increased silting of rivers and harbors, etc. Furthermore, always remember that those losses which permanently reduce productive capacity cannot be calculated. How can you place a proper value on a lost productive capacity which would have produced commodities over many scores or hundreds of years?

By contrast, the cost of *doing* the job—of protecting the indispensable soil and water resources of our farmlands—would be a great deal less. In all probability, the total cost of *doing* the job would be less than one-third the cost of *not doing* the job!

The federal government's share of the cost of protecting our farmland soil and water resources during the next 20 years would amount to about one-twelfth of the nation's total bill if the conservation job is not done.

And remember, too, that after the 20-year period—after the basic conservation measures are applied to the land—the bulk of the job will be finished. After that is done, necessary maintenance and improvement work will be much easier and cheaper.

What a frightful lack of foresight, and what terribly false economy it would be, if we did not go ahead with the soil conservation job!

STRENGTH OF NATION IS IN GOOD LAND

Let's now consider it from another point of view—that of our continued existence as a healthy, productive nation, capable of standing steadily, effectively on its own strong feet. In this light, soil conservation is one of the two most necessary jobs confronting the country. The other—equal in importance—is to keep the nation out of another war. Failure in either will cost the life substance of our civilization.

The 20-year period for completing the basic work of conservation could be extended, but at the same time the cost would be extended and increased. Moreover, if we postponed and put off in this way for too long, our supply of good land would dwindle to a level insufficient for our national needs. If we were to turn from scientific soil conservation and adopt the costly, unscientific practice of applying poultices of alleviation to the patient, we would wind up probably in less than a hundred years with the outright loss of the productive capacity of at least 50,000,000 additional acres (500,000 one-hundred-acre farms) and severe damage to all but about 100 million acres of our very best land.

We couldn't continue to function as a healthy, sound nation under such inconceivable

circumstances. We would be a sick nation in many ways and year after year we would have to look abroad, to foreign lands, for the food to feed ourselves.

On the other hand, within 20 years we could do the basic or main conservation job on 400 million acres of cropland and 600 million acres of other kinds of farmland needing treatment at a maximum cost of $2.00 an acre as an average for governmental assistance—federal and state—and a maximum cost of $4.00 an acre as an average to the farmers of the country. I say these would be "maximum costs" because accruing benefits of the work would sharply reduce these cost figures to both the government and the farmers. The benefits might equal or even exceed the cost in that time; they would certainly exceed costs within a few years after completion of this job.

So, from the standpoint of national economy and our survival as a productive nation, there is no valid alternative to a strenthened soil conservation program of the kind now being advanced through soil conservation districts. I feel sure the nation will insist on it.

FUTURE LAND DEVELOPMENTS ARE CLEAR

What else will be happening, with respect to the land, during the next 20 years, and in the 30 years thereafter? Some of the developments, I think, can be foreseen with fair clarity. Here in the United States, for example, conservation of soil and water resources will first become a major national objective and then it will become an accepted, customary part of the American conduct of affairs.

With few exceptions, each acre will be treated according to its needs and used according to its capabilities. This will become a fundamental practice among American farmers. I am sure of this because no other method of handling the land will protect it against erosion or insure its continued productivity. That is a certainty based on the physical facts involved with our complex conditions of land, climate, and types of agriculture.

Agricultural production will be more diversified and the per-acre yields will be increased, both here and in other countries practicing soil conservation.

That other nations around the world will adopt soil and water conservation measures must be regarded as a foregone conclusion. The overwhelming urge of mankind for survival dictates such a course. Before many more years have passed it will become at once apparent and imperative to all that every remaining productive acre must be handled in such a way that it will continue to produce indefinitely.

As a result of soil and water conservation work, agricultural production will be restored or improved in millions of communities throughout the world. This, in turn, will help solve to a considerable degree some of the most pressing problems of famine, food distribution, and human nutrition now confronting mankind.

The development of land and water resources for agriculture—as by drainage or irrigation—will be governed primarily by factual, technological elements of land use and land maintenance, rather than by promotional, exploitive, or political standards.

LAND OWNERSHIP PATTERNS WILL CHANGE

Some of the fantastic patterns of land ownership, such as can be found in parts of Europe and Asia, and even to a limited extent in parts of the United States, will be corrected. The operation of very narrow segments of land, resulting from progressive axial division among heirs, does not permit the owner to engage in economic production or practical soil conservation work.

Various governmental encouragements, such as preferential real estate tax rates during the period of applying soil conservation measures, may possibly be adopted.

Farming will tend to become an expert profession; the inexpert and the inept are likely to be forced gradually off the land.

Most important, man will have learned the true value of his irreplaceable, most priceless natural resource—productive land.

The groundwork has been laid. Ahead, for soil conservationists and for the science of soil conservation, is one of the biggest, most interesting, and rewarding jobs ever undertaken for the improved welfare of mankind.

U. S. AND WORLD PROGRAMS ARE PROPOSED

At this point I am going to propose an 8-point soil and water conservation program for the United States and a 6-point program for the World, which I believe soil conservationists and other scientists interested in natural resources, as well as responsible citizens everywhere, can subscribe to readily. I will not undertake to enlarge on these points here, except to state that they are based on the pioneering experience in soil and water conservation that we have had to date in the United States.

For conservation of soil and water resources on the farmlands of the United States I propose:

1. An acceleration of the soil and water conservation program, through soil conservation districts, on the basis of the needs and capabilities of the land itself. The program should be geared to complete, within the next 20 years, the basic conservation measures required to maintain and improve the productivity of the farmlands of the nation.
2. The drainage of some 30 million acres of good land to improve the production of that part now in cultivation, and to bring into cultivation, as needed, certain areas now too wet for tillage of any kind, although consisting of potentially high class cropland. Much of this wet land is in soil conservation and drainage districts and most of it already has been cleared for cultivation. (Such drainage work would help toward a needed shift away from cultivation on an equivalent or larger acreage of steep, erodible upland which should go out of cultivation and into a permanent protective cover of trees, grass, or legumes.)
3. The rehabilitation, development, and better utilization of land and water resources on approximately 12 million acres, largely in sub-humid areas.
4. Purchase by states, soil conservation districts, or the federal government, of lands in hazardous areas which are in acute need of protection for soil and water conservation, especially where proper treatment cannot be accomplished by individual farmers. When such lands have been properly treated and brought into productive use, the policy should be to sell them to responsible buyers on the open market, with adequate safe-guards, as to use, for their continued productivity.
5. Quick completion of a land capability survey of all the farmlands of the country.
6. A broadened educational program, through the school and university system of the country, and through all other appropriate avenues for the dissemination of information, to acquaint children and adults alike with the importance, condition, and needs of their basic agricultural resources.
7. The initiation of scientific investigations, on a comprehensive basis, into the relationship between soil health—with particular emphasis on the effects of erosion—and human health and nutrition. Authoritative information on this promising approach to human betterment is wholly inadequate.
8. Improvement of the Nation's range and pasture lands through grass and livestock management, water development, and erosion control. Under modern conservation practices for range lands, maximum improved production on a sustained basis is possible.

6-POINT WORLD CONSERVATION PROGRAM

As an essential beginning to world-wide conservation of remaining areas of productive land, I propose, as a scientist, that each nation:

1. Make a quick reconnaissance survey, on the ground, of the extent and severity of soil erosion within its boundaries.
2. Establish in the principal type areas one or more soil erosion research stations to determine: (a) the rate of soil erosion and the amount of water loss under different kinds of land use, (b) the causes of soil erosion, and (c) the best methods for control of soil erosion.
3. Establish erosion control demonstration projects of substantial area (perhaps 10,000 to 25,000 acres in size) in the principal areas having a distinctive regional type of agriculture, to test and demonstrate soil and water conservation measures under practical farming conditions.
4. Develop a national program of soil and water conservation, including both immediate and long range objectives, together with a chronology of the actions necessary to reach the objectives. Inherent in such a program is a survey and analysis of the land to determine the capabilities of each important segment for various uses (as for cultivation, grazing, forestry, or wildlife) and the conservation treatment required to maintain the land permanently in its highest state of productivity under its most desirable use.
5. Participate in international activities (such as the Food and Agricultural Organization of the United Nations) and otherwise encourage such actions as will facilitate the international exchange of scientific information on the conservation of soil and water resources.
6. Carry on educational work in soil and water conservation with both the rural and urban populations, especially through the school and university systems, emphasizing the vital importance of land and water resources.

Determining Range Utilization By Frequency Tallies

BY BEN OSBORN

BEN OSBORN is ranch conservationist for the Soil Conservation Service at San Angelo, Texas, where he assists ranch operators in three soil conservation districts. A graduate of Oklahoma A. and M. College in 1931, he has been engaged in conservation work dealing with natural vegetation since 1935.

THE DEGREE to which range vegetation is grazed is recognized as the key to its improvement or deterioration. Standards of "proper use" have been established by public agencies for different species in the range areas in which they operate. Range management is designed to regulate grazing so that the use of key species will not exceed these "proper use" factors, or total use of mixed types will conform to the averages of these factors weighted in accordance with the relative abundance of the species in the types.

It is important to successful range management, then, to be able to recognize when the allowable percentage of use has been attained on each range area; or, more specifically, to measure or estimate the actual degree of use at a particular time and compare it to the "proper" percentage for that same area. Various methods have been devised to do this. Each has its advantages, but many are unsatisfactory for widespread use by field men who must make quick appraisals of large numbers of range units within a short season. This results from the time and labor required to collect the data essential to the determination or needed to construct local charts or tables required as standards for field estimations.

To overcome this handicap, a system of tallying frequency of occurrence of different species, and the percentages of each completely grazed, partially grazed, and ungrazed, has been used with considerable satisfaction in several soil conservation districts in central and southwestern Texas.

Description of Method

The frequency tally makes use of a combination of features suggested by methods developed at the Southwestern Forest and Range Experiment Station (1, 2, 4) with modifications.

Collection of data. A representative sample of the vegetation in its existing state of use is obtained by pacing a transect through a range type or pasture, stopping at regular intervals and recording the species and degree of use of one or more plants nearest the toe of the right foot. The course of the transect is selected to provide a proportionate sample of the different conditions of composition, density, and utilization in the area under consideration. The spacing of the points of observation, and the number of plants to be tallied at each point, should be calculated in advance to secure data on a minimum of 100 plants in traversing each area. It has been found practical to record up to five plants at each stop.

The data may be recorded and the computations made on any ruled pad with vertical columns headed across the top, as illustrated in Table I, as follows: (1) Species; (2) Fully grazed, number and (3) Per cent; (4) Partially grazed, number and (5) Per cent; (6) Not grazed, number and (7) Per cent; (8) Composition, number and (9) Per cent; (10) Actual utilization, per cent and (11) Weighted per cent; (12) Proper utilization, per cent and (13) Weighted per cent. As each plant is identified,

a dot or mark is placed opposite its name in the appropriate column according to whether it is fully, partially, or not grazed.

A plant is considered fully grazed when all the foliage has been removed, leaving only a stubble or coarse stems; and not grazed if less than ten per cent of the foliage has been removed. Those falling between these two extremes are considered partially grazed, as are also those having ungrazed or partially grazed regrowth following complete utilization earlier in the season. Annuals which have not reached the blooming stage, and seedlings which have not reached a size suitable for grazing, or ungrazed perennials of such low vigor that they did not reach a certain minimum (as one inch) are ignored. Grazed plants are recognized by truncated stems or blades, missing leaves or buds, or other evidence of removal of forage, not by size or height alone which may be misleading in cases of low vigor or poor growing conditions.

Computations. Composition by species is calculated by totaling the number of plants of each species and figuring the frequency of occurrence for each as a percentage of the total plants recorded.

The percentage of actual use for each species is obtained by figuring first the percentage of the total plants of that species recorded in each of the three degrees of use. Assuming that those plants recorded as partially used average being 50 per cent used, half of the percentage obtained for this class is added to the percentage in the "fully grazed" class to give the percentage of all the plants of this species which would be completely used if all the grazing were concentrated on a minimum number of plants.

When this percentage has been obtained for each species, the average utilization for the type is calculated by multiplying the percentage of use for each species by its percentage in the composition, and dividing the sum of these factors by 100. To base utilization estimates on only the important species, those comprising less than five per cent of the total composition, or all except selected key species, may be omitted from the computations.

To compare the percentage of "actual" use with the "proper" for the type, the appropriate "proper use factors" are entered in the final column and the weighted average proper use for the type is calculated. The per cent of actual use divided by this figure gives the per cent of "proper" use at the time of the examination.

Tallies in browse types. The number of stems or twigs browsed has been used as a basis for determining degree of utilization of woody

TABLE 1.— EXAMPLE OF COMPOSITION AND USE (FREQUENCY) TALLY

Species	Fully grazed		Partially grazed		Not grazed		Composition		Actual Utilization Weighted		Proper Utilization Weighted	
	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Buffalo	2	8	14	58	8	33	24	24	35	828	60	1440
Sideoats	8	73	3	27			11	11	87	957	70	770
Texas speargrass	1	13	7	77			8	8	51	408	50	400
Prairie dropseed	1	50	1	50			2	(2)				
Hairy grama			2	50	2	50	4	(4)				
Little bluestem	7	70	3	30			10	10	85	850	60	600
Windmillgrass	2	40	3	60			5	5	70	350	30	150
Threeawn	4	17	13	45	11	38	29	29	39	1131	10	290
Hairy triodia	1	14	3	43	3	43	7	7	36	252		
Col. 10 = Col. 3 ± ½ Col. 5							100	94	94	)4776	94	)3650
Col. 11 = Col. 9 × Col. 10										51%		39%
Col. 13 = Col. 9 × Col. 12												

Actual utilization 51%

Proper utilization ..... 39% = 130% of proper

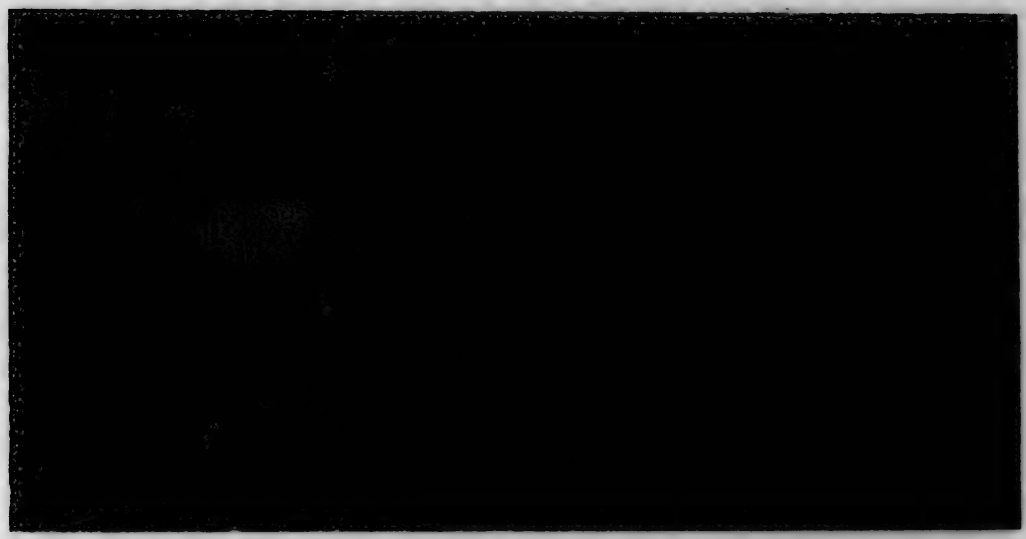


Figure 1. A sideoats grama plant, one of the most palatable of grasses, has been selected by cattle from amongst an almost pure stand of tobosa grass and has been partially grazed in a lightly used range. Further use of the range would likely result in regrazing of the sideoats plant, reducing it to a fully used condition. Tallies of a sufficient number of individual plants will reveal the percentage of use which has occurred.

plants by big game (3). The frequency tally employs this principle to determine degree of utilization of browse. The branchlet, rather than the entire plant, is the most convenient unit to be tallied. A branchlet is considered fully utilized when 90 per cent of the current year's twigs and leaves have been removed, and not utilized when less than ten per cent has been taken. Examples between these extremes are considered as partially utilized.

In winter, browsing of deciduous species can be recognized by the presence or absence of leaf buds. If a twig has its terminal buds intact, it has not been browsed. If the terminal buds are missing but some lateral buds are evident, it has been partially used. If no leaf buds are present, all the current year's growth has been removed.

In types consisting of both herbaceous and woody species, these groups are recorded separately. At each point in the transect, after recording the predetermined number of grasses and weeds, if any shrubs are within reach a similar number of branchlets are selected for examination. These should be picked at random from the different plants within arm's reach of the tally point, in proportion to the abundance of each species at that location, and at different heights from the ground within reach of livestock. At the conclusion of the tally, separate estimates are made of the forage density of the ground cover (grasses and weeds) and of the browse. The total composition of the type is apportioned between the two groups in proportion to their forage densities. The composition within each group is first computed separately as previously described, then these percentages are reduced proportionately to make the total for each group the same as the percentages based on forage densities.

From this point, computation of the percentages of use by species and for the type is the same as first described.

Figure 2. Every plant visible in this picture has been fully utilized. The fortunes of range vegetation are governed largely by the degree and frequency with which the foliage is removed by grazing. Plants that have no opportunity to carry on their normal life functions of photosynthesis and reproduction die out, leaving the less palatable ones until they too are consumed by livestock. Range management requires discrimination to recognize when safe limits of use of the more palatable and superior plants have been reached.

ADVANTAGES AND DISADVANTAGES

Desirable features of the method include the following:

1. It is rapid. One man can make the tallies and complete the computations for a small farm pasture in an hour, or a section or several sections of range land in a half day.

2. The computations can be completed in the field so that the results can be checked by general observation and unexpected or erratic answers can be verified or corrected by additional data before leaving the pasture.

3. It is not necessary to clip or measure ungrazed plants to obtain data as a basis for computing percentage of use.

4. Differences in vigor or volume of growth of the same species in different pastures or on different sites do not affect the percentages obtained, since the utilization of each individual plant is judged by comparison with the total growth of that particular plant.

5. The determinations may be made at any time of the year, giving results in terms of utilization to that date of whatever growth each species has made to that same date.

6. Regrowth of certain species does not seriously complicate the determinations. Stubble of earlier growth is usually evident.

7. Weighted average utilization for the sample is calculated on the composition of the sample itself, and compared to the weighted average proper use factor for identically the same sample.

8. Browse species may be included in the same determinations with grasses and weeds.

Unfavorable features of the method include the following:

1. Percentages of composition are in terms of numbers of plants, which may not be exactly proportional to either volume of growth or per cent of ground covered.

2. The relationship of percentages of utilization as determined by this method to percent-

ages determined by weights of forage has not been established. Some adjustments in proper use factors to conform to results obtained by the tally method may be needed.

3. In some cases the plants of certain species recorded as partially grazed will have been used more or less than an average of 50 per cent. This error can be overcome, however, by using a higher or lower assumed percentage of use for the partially grazed plants of any species where this condition is obvious. The examiner should note any such deviation from standard practice.

SUMMARY

The frequency tally which has been used in soil conservation districts in Texas is a rapid method of determining composition and degree of use of range vegetation. It is based on a count of a random sample of individual plants, classified into three use classes; namely, fully grazed, partially grazed, and not grazed. Composition is calculated as the percentage frequency of occurrence of each species. Percentage of use for each species is computed as the total of the percentage of plants of that species fully grazed plus half the percentage partially grazed. Weighted average percentages of actual use and proper use can be compared to indicate the existing degree of use of the sample. Both grassland and browse types, or a combination of these, can be evaluated by this method.

REFERENCES CITED

(1) *Canfield, R. H.*, 1942. A short-cut method for estimating grazing use. Southwestern Forest and Range Experiment Station, Research Note 99. Tucson, Ariz. 5 pp., mimeo.

(2)———, 1944. A short-cut method for checking degree of forage utilization. Jour. of For. 42(4):294-295. April.

(3) *Dalke, P. D.*, 1941. The use and availability of the more common winter deer browse plants in the Missouri Ozarks. Trans. Sixth North Amer. Wildl. Conf. pp. 155-160. American Wildlife Institute, Washington, D. C.

(4) *Parker, K. W., and Glendening, G. E.*, 1942. A method for estimating grazing use in mixed grass type. Southwestern Forest and Range Experiment Station Research Note 105. Tucson, Ariz. 5 pp., mimeo.

DEMOCRACY

(Continued from page 42)

racy cannot continue without such technical help, which no other agency is equipped to provide.

BUILDING SECURITY FOR AMERICA

But may I again emphasize that we are moving fast but not fast enough. As with better conservation education, with increased State appropriations and participation, with more activity on the part of the State soil conservation committees, so, too, do we need to accelerate technical assistance to the farms in districts. We need to devise better techniques, faster procedures, but we must not sacrifice quality. The science of soil conservation is not a formula program that can be applied indiscriminately to all farmlands; it is based on the concept that every acre has a proper use and must be treated according to its needs and capacity for production.

It has been a signal honor to speak to you at this first annual meeting of a new society dedicated to the advancement of the science of soil and water conservation. I am appreciative of the opportunity to convey to you my thought that our free society could not survive the loss of its basic, irreplaceable, resource—the soil. After many years of trial and error, we have laid a firm foundation for a national program. Let us now build upon that foundation. Soil conservation in our democracy is an infant in swaddling clothes. Through cooperative, progressive, dynamic methods we must nourish that infant into a hardy, mature citizen for the everlasting benefit of posterity.

Let our vision never be clouded by inconsequential or extraneous issues. Let us have the courage that is the need of every great enterprise. Let us work under the ever present stimulus that we are safeguarding the future of our children and building security for America.

FOREST CONSERVATION

(*Continued from page 30*)

favor conifers over hardwoods to increase interception and evaporation.

Also where flood control is needed, the forester would do other things. Where snow is not a factor and where hardwoods predominate, he would encourage conifers in the stand. Where coppice forests are common, he would encourage the timber type of forest and discourage short rotations. He would encourage over others, those species which are gross water users. He would encourage a dense understory of small trees, bushes, and grass. He would give particular attention to maintaining a dense cover along streams. The forester would do all these things because he would want to increase the transpiration and evaporation draft just as far as possible. In so doing he would be endeavoring to increase the infiltration and water-holding capacity of the soil in order to prevent surface run-off, to hold the water back from the streams, to increase evaporation losses from the crowns, and to keep the abstraction of water from the soil at a maximum at all times. The more pumps he can keep in operation, the better and more efficiently these pumps work, and the longer time they can be kept functioning, the more the soil reservoir can hold when flood conditions develop.

Up to this point, we have given primary consideration to the water resource. However, in all of his work, the woodland manager must always be conscious of the soil as well. He must because water relations are essentially soil relations.

One of the important phases of the water resource is its quality. To many water engineers, water quality means primarily and sometimes almost exclusively hardness or bacterial condition. To the conservationist, quality also means its silt content and the other sediments it carries. It is a source of real regret that there are many practicing foresters who fail in their work to recognize that the quality of water delivered to a major stream or to a reservoir may be and often is conditioned by both the practices followed on a watershed, but also by the manner in which they are carried out.

Increased water yields are possible through removal of water-using trees. But, the manner of removing the logs can be so damaging as to offset the benefits from those yields. It is our firm belief that logging methods result in far greater damage to the water and soil resources than is caused by improper silviculture. Skid roads gouged deeply into the soil as the logs are dragged down hill may cause gullies that eat to bed rock, the soil finding its way quickly to the stream. Logging roads poorly located as up a water course, across a meadow, or along a slope, may not only establish a new cycle of erosion but may also develop a new drainage pattern. And such patterns may persist for many years, perhaps centuries. All too often foresters believe they have solved the problem by throwing slash into the skid-way. But in such cases, even after erosion has ceased, the drainage pattern persists.

Associated with logging damage in reducing water quality through erosion are roads. The vast network of roads that have been and are currently being built through the woodland and forest areas of the country are seriously damaging water quality. Many roads are being located without any reference to the erositivity of the soil. In part, this is due to the lack of a quick and ready method for determining whether a given soil will erode upon exposure, but more often is due to a lack of unconcern by the roads locater.

The maximum conservation of soil and water cannot be achieved by vegetation alone. Engineering measures are also necessary, but as land managers, we must place our main reliance on vegetation with structural devises only to strengthen or supplement the land measures.

GRAZING AFFECTS WATER SUPPLIES

Most conservationists recognize that livestock in woodland areas is a source of damage. Such grazing often kills out the minor vegetation, permits wind to dissipate the litter, and so

(*Continued on page 58*)

From the President

UNDERSTANDING and applying the Science of Soil and Water Conservation requires a new kind of specialist.

The professional soil conservationist starts with the land. He must be proficient in the knowledge of adjusting land use according to its capabilities and treating each acre in accordance with its needs. He not only correlates all other necessary sciences into a workable and economically sound soil conservation plan on an acre by acre basis, but also gives the necessary technical assistance for the thorough application of the plan on the land.

With this as a basis he brings into play all of the associated sciences required to plan and apply a total program of soil and water conservation. He understands and uses the principles from such fields as engineering, agronomy, forestry, biology, hydrology, physics and other sciences which contribute to soil and water conservation. He must have a sense of practical application and management. He must be something of an applied psychologist and economist, and he must have a sense of social responsibility.

Although this is an era of specialization, the great need is for the coordination of specialized techniques to solve a problem or correct a bad situation. This is true in more fields than conservation. There are two major problems facing the people of the world: first, how to get along with each other and second how to adapt ourselves to our environment and use land resources to insure sustained productivity. Neither of these problems have been solved nor will they be solved by the professional soldier or economist; by the engineer or the agronomist. They will be solved by persons, regardless of their original specialized training, who can focus on the problem all of the applicable facts from the world's fund of information and experience.

The field of soil nutrition and its relationship to human health is new but available facts point definitely to the relationship of good soil and good health. The stability of industry, business, the church and the schools lies squarely in the soil. As one prominent industrialist puts it, "When the land is cut the city bleeds." Land depletion and economic complications go hand in hand. What the professional soil conservationist does will have its impact on social and spiritual aspects. His work will have reverberations throughout the whole world.

It is to the professional soil conservationist that we look for guidance in the application of the science of soil and water conservation to the land in a scientific manner. He carries a heavy responsibility to the public.

Since the science of soil and water conservation is a relatively new one, the professional soil conservationist has one of the most difficult jobs in the technical field—the coordination of related sciences into a sound soil conservation plan applied to each acre of land.

The soil Conservation Society of America, also a new professional society, firmly established will play an important part in the development of this profession.

R. H. Musser

—R. H. Musser.

FOREST CONSERVATION

(*Continued from page 56*)

compacts the soil as to reduce its infiltration capacity. These effects in turn result in increased surface run-off and in erosion. Many of our western streams today show all too clearly the results of the past 75 years of watershed abuse by grazing. But it is not alone in the west that woodland grazing is causing damage to the water quality of our streams. Throughout a large area of the eastern hardwood region, woodland grazing is responsible for considerable washing of the surface soil because the ground cover is destroyed under the canopy.

There is another type of grazing to which conservation should give close attention. This is caused by big game. In many game refuges and in some other areas where present game laws are permitting these game animals to increase rapidly, just as much damage is being caused the water resources as by domestic livestock. Those of us who are concerned with soil and water should watch all such situations carefully lest irreparable damage be done to the resources.

Just why livestock and game concentrates on certain areas and do them so much more damage than elsewhere has long been a mystery to me. However, Prof. Albrecht's work in Missouri would appear to offer a clue, the animals concentrate where the most delicious food is to be found. Who knows, perhaps we can obtain better distribution of livestock by the use of the right kind of fertilizer or the rare elements.

There are other lines of action which the forester may follow in improving water quality through improving the soil. One of these is through reforestation. But so far, foresters generally fail to differentiate between the erosive characteristics of soils when developing planting plans. They plant the same timber producing trees on actively eroding and non-eroding soils, and they use the same planting methods. If the silvicultural or economic rules call for planting trees 10 by 10 feet apart, that spacing is adopted even though for soil protection purposes a 4 by 4 spacing is required.

Then, too, foresters and conservationists generally should unite to sponsor and encourage a greater appreciation of the place windbreaks and shelterbelts should occupy. These forms of woodland are often overlooked, but we find them most effective in preventing blowing of light soils. And they do aid in reducing evaporation and in conserving moisture.

SUMMARY

In general, if we can summarize the national situation with reference to where foresters now stand in soil and water conservation, it would be about as follows: foresters recognize that forests control erosion probably better than any other type of natural cover. They recognize watershed protection as a major objective of forestry. They recognize that some forest practices and forest abuses can result in floods and mud-flows. They recognize that protection forestry is a good thing in the abstract, but do not recognize it as a practical matter. They do not yet realize that management can also affect water yields, or the time and rate of flow. They are not yet ready to accept the possibility of forest treatment and forest planting as positive agents in the control of soil and water. In convincing them to adjust their thinking and approach to the problem; in getting across to them the idea there is much more to forestry than timber production, the Soil Conservation Society can be a leading exponent.

PRESIDENT'S ADDRESS

(*Continued from page 8*)

whole-hearted participation of its members. Maintaining high standards, generosity in dealing with others, full cooperation, and initiative are principles which will insure success in the attainment of its objectives. There is a rapidly growing consciousness in the public mind as to the value of our land and the need for soil and water conservation. Science is assuming a more permanent and practical role in our everyday affairs. Herein lies the greatest opportunity for service ever afforded man.

BOOK REVIEWS

THE CALIFORNIA GROUND SQUIRREL. *By Jean M. Linsdale. University of California Press, Berkeley and Los Angeles, 1946. 475 pp. $5.00.*

MAMMALS OF NEVADA. *By E. Raymond Hall. University of California Press, Berkeley and Los Angeles, 1946. 710 pp. $7.50.*

WILD ANIMALS affect in many ways man's use of the land. Some animals are considered beneficial, others are thought of as harmful, still others are a known source of food, fur, and recreation. The true worth of birds and mammals, however, is often obscured by ignorance and prejudice. Practices for managing animal populations are frequently based on an inadequate knowledge of the ecology of the species concerned. The indiscriminate control of rodents and predators are examples of activities of questionable merit and basis that have caused the futile expenditure of vast sums of money, have sometimes caused harm, and often have clouded our vision of problems by giving us a false sense of accomplishment.

Two recently published books are excellent sources of biological information that conservationists can use. One by Dr. Jean M. Linsdale is on the California ground squirrel. The other by Dr. E. Raymond Hall is entitled "Mammals of Nevada."

Rarely has an animal's species been subject to such a thorough study as has the California ground squirrel by Dr. Linsdale and his associates at the Hastings Natural History Reservation near Monterey, California. Almost ten years of continuous observation have resulted in interesting conclusions. Ground squirrels resemble some kinds of plant weeds that have increased in numbers and spread over larger areas where certain kinds of land use are practiced. Grazing and moderate cultivation improves the habitat for squirrels, whereas the cessation of these human activities decreases the amount of suitable habitat. The squirrels respond quickly to these changes, their numbers increasing or decreasing with changes in the suitability of the habitat. Where these animals take heavy toll of cultivated crops such as grain, garden vegetables, and fruit, protective or control measures should be taken against them. At Point Lobos, California, poisoning the squirrels had no permanent effect upon their numbers and after one season there were more squirrels than there had been prior to the poisoning. The reduction of their habitat by increasing vegetative cover is a successful way to control the squirrel population. The squirrels can be effectively removed from an area for long periods of time by destroying their burrows or blocking the entrances to them.

Dr. Hall's book is more than a taxonomic catalogue of the mammals of Nevada, for it is filled with observations upon the ecology and comments upon the economic importance of the species that occur in this state, many of which are common to other western states. The conservationist will want to read the accounts of the game mammals and fur-bearers, and of the coyote, badger, pocket gopher, and black-tailed jackrabbit. Dr. Hall's intelligent discussion of coyote control is a must for anyone concerned with western grazing land. He reviews in detail the history of coyote control in Nevada, its costs, methods, aims, and alleged gains and losses. Then Dr. Hall states a few facts bearing upon the control question, gives his personal views, and offers a suggested plan for dealing with the coyote problem in Nevada.

These books by Linsdale and Hall will aid the soil conservationist in learning about the true place of wild animals in the picture of land utilization.—Lawrence V. Compton.

NATURAL PRINCIPLES OF LAND USE. *By Edward H. Graham. New York: Oxford University Press, 1944. 274 pp. $3.50.*

EDWARD H. GRAHAM'S "Natural Principles of Land Use" is a study of land management biology in fourteen interesting chapters. The text is amply illustrated with dramatic half-tone photographs, many of which show damaged land before and after receiving conservation treatment by landowners.

Knowledge of natural resources and nature's laws, the author shows, can be used to improve and manage land. Ecology evaluates nature's system of bookkeeping; in other words, it is a study of the effects of environment on plants and animals and, conversely, the effects of plants and animals on environment.

Primitive man lived in harmony with nature, taking only the natural increment of the land without checking against the basic reserves of soil, plant and animal life. Civilized man, with his plows and large herds, has been a more destructive influence on natural resources.

One chapter deals with the natural resources and factors which aid in distribution of plants and animals such as: climate, physiography and soil. Soil is often regarded as lifeless crust, but here it is depicted as it really is. The top soil has a far greater population than the earth's surface, for it is the abiding place of countless bacteria, protozoa, molds, roots of grasses, herbs and trees, plus insects and burrowing vertebrates. One statement reads: "Investigations have shown that the earth in England harbors fifty thousand earthworms to the acre, an acre of Maryland meadow supports 13,500,000 invertebrates at no greater depth than "a bird can scratch," and the soils of the Russian Steppe maintain 415,000 ant nests per square kilometer. Ninety-five per cent of all the insects invade the soil at some period in their lives."

There are certain climax grasses like little bluestem near Fort Worth, Texas, that signalize a healthy landscape where one like threeawn is a true marker of range deterioration.

Living things are interdependent, as Graham points out. "The cat eats the mouse, the mouse eats the grain." When the harvest fails, both cat and mouse die or go on short rations, just as humans and animals do when crops and grass fail because of drought.

Several chapters give illuminating illustrations of how land management biology can be used to further eventful conservation programs on farm land, forests, ranges and pastures, and wildlife areas. The discussions on predators, rodents and insects are valuable innovations. There is a general idea flitting about that rodents and insects cause range deterioration. This book provides innumerable examples of proof that pestiferous insects and bothersome rodents usually increase after the original plant cover has been modified by grazing animals or by other causes. For example, on the Wichita Mountains Wildlife Refuge in Oklahoma, the ratio of insects in overgrazed short grass range to good bluestem ranges was as follows: beetles 2.3, bugs 6, cicados 4.3, bees and wasps 4.6, and grasshoppers 9.

The chapter on "The Land and Human Welfare" is loaded with intriguing challenges for educators and land planners to mull over. Man is the product of the soil and the deficiencies of the soil are transmitted to those who eat food grown on deficient soil. He says, "The 'Oakie' and 'Arkie' are not so much the results of poor human inheritance or the unscrupulous banker as they are symptoms of wasted land and false land management."

Graham has drawn a lot from his own experiences but he has also raked through a maze of technical writings for much of his subject matter. He has converted the facts from these technical writings into an extremely readable book. By switching from three-inch scientific terms to half-inch words, he has brought a vast amount of scientific information within practical grasp of both landowners and scientists without sacrificing accuracy. There is universal need for interpretative writing of this type.—B. W. Allred.

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INTERNATIONAL HARVESTER

Notes and Communications

300 Years To Learn Conservation

I have received and read with genuine pleasure the copy of the JOURNAL OF SOIL AND WATER CONSERVATION that you sent me. I should like to congratulate you on producing such an excellent publication. As other commentators have said it is at once sufficiently technical to satisfy the scientifically inclined, and at the same time interesting to the lay-man. We should certainly like to subscribe for it and I am passing your membership blank to the Rothamsted Experimental Station.

We do not have much literature on conservation in this country. Not because we don't practise soil conservation but because we never practise anything else. I can say this without boasting about my countrymen since it took them 300 years to learn conservation, but they have completed the job now and the problem no longer exists.

I shall however, be pleased to keep you informed of any developments that come my way in connexion with conservation in other countries of the Commonwealth. For example, I can strongly recommend a book called "*Soil Erosion in New Zealand*" by K. B. Cumberland, published by the Soil Conservation and Rivers Control Council, Wellington. This gives a most interesting and graphic account of the problem.

G. V. Jacks, *Director*
Rothamsted Experimental Station
Harpenden, Herts
England

Field Observations on Land Reclamation in Byelorussia

I would like to pass along a few observations on soil conservation and land reclamation that I had an opportunity to make in Byelorussia during the spring and summer of 1946. From April until August, I was in Byelorussia as Agricultural Adviser on an UNRRA Mission. In that capacity I had an opportunity to travel rather widely over that republic and visit many farms and several agricultural experiment stations.

The climate in Byelorussia is much like northern Minnesota and Wisconsin. Much of the landscape looks like our northern lake states, with pine, fir, white birch, small inland lakes, peat bogs, sand ridges, and wide level plateaus suitable for cultivation. The topography is only slightly rolling except on the divide between the Baltic drainage area and the drainage toward the Black Sea. This divide is in northern Byelorussia, and even here the hills are low and mostly in cultivation. The plateaus of farm land are bordered by the depressional areas which extend into peat bogs or marshes. The peat bogs are usually rimmed by good stands of pine and fir. There is still much good standing timber in Byelorussia. Many of the plateaus are so large and treeless that they give an appearance of typical prairie areas. It is my impression, however, that the entire area was once covered with pine forests and certainly the soils give evidence that this was true.

DROUGHT HAZARDS NEGLIGIBLE

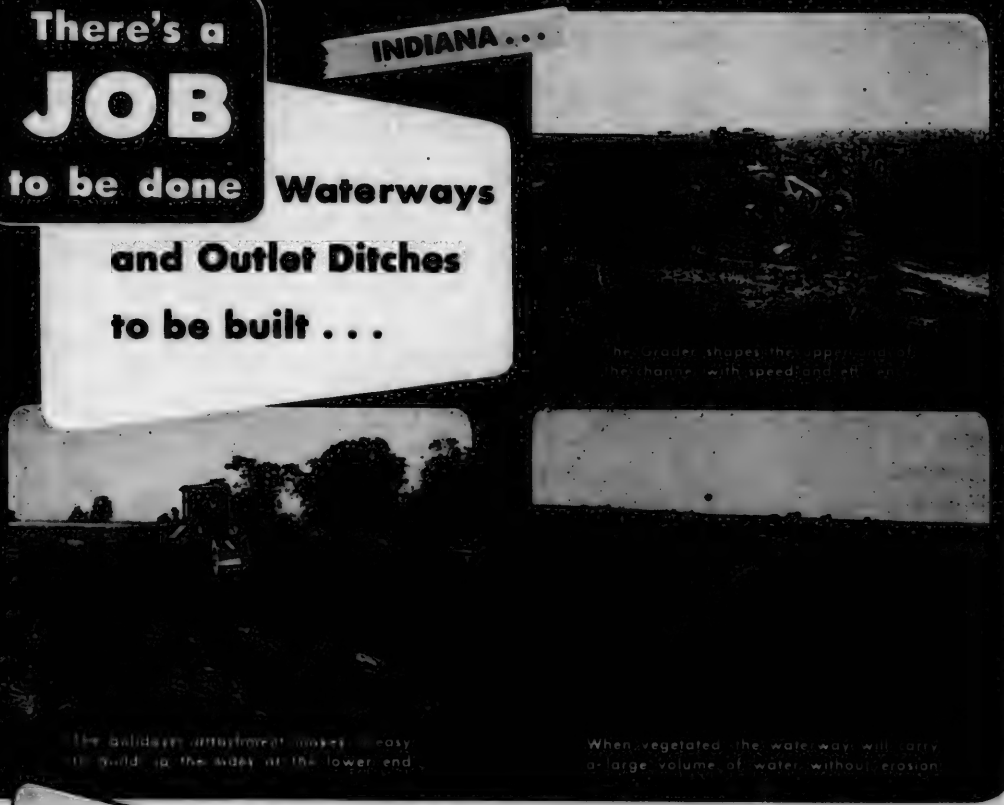
Rainfall is reported at about 24-30 inches, distributed throughout the growing season so that drought hazard is negligible. Rainfall is usually gentle compared to our torrential summer storms. Temperatures during the summer are relatively low. The days, of course, are very long during the growing season. During the summer of 1946, temperature and rainfall were such that bluegrass pastures greened up about May 1 and were still green the middle of August when I left. Clover seed which we were distributing for UNRRA arrived rather late. June 1 was considered the last safe date for seeding by most of their agronomists. I saw

(*Continued on page 64*)

There's a JOB to be done

Waterways and Outlet Ditches to be built . . .

INDIANA . . .

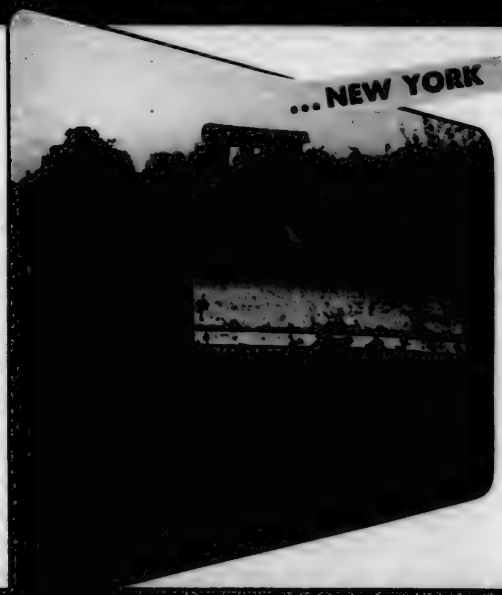


The grader shapes the approaches of the channel with speed and efficiency

The Austin-Western moves easily to build in the sides at the lower end

When vegetated, the waterway will carry a large volume of water without erosion

. . . NEW YORK



Where to locate a water outlet, and what steps to take to stabilize it, are important items to be considered in every field plan, regardless of whether contour cultivation with strip cropping will suffice, as in the photographs of the Indiana waterway; or whether terraces are required, as in the photograph of the New York outlet ditch.

Because of increased velocity and depth of flow caused by confining the water in such artificial channels, considerable precaution is necessary to avoid erosion. Channels must be properly designed, constructed and stabilized, and considerable earth must be moved, which accounts for the popularity of the "99-H" Power Grader, with its exclusive All-Wheel Drive and All-Wheel Steer, on work of this sort.

AUSTIN-WESTERN COMPANY, AURORA, ILLINOIS, U. S. A.

Constructing an outlet ditch to receive the water from a series of diversion terraces

BUILDERS OF ROAD MACHINERY

Austin Western

SINCE 1854

RECLAMATION IN BYELORUSSIA

(*Continued from page 62*)

red clover seeded as late as the first week in July without a cover crop. The rainfall and temperature were conducive to a good stand, and apparently there was going to be enough growth by fall to go over the winter in fairly good shape.

On my inspection trips to farms throughout the republic, I noted some evidence of sheet erosion on slopes, but nowhere did I see bad gully erosion. Agricultural officials and farmers were so weighed down with problems of recovery from war destruction that I was unable to get any display of interest in the problem of erosion through direct questioning about it.

SWAMP LANDS ARE RECLAIMED

At an early conference with the Minister of Agriculture stationed at Minsk, one official was introduced by the interpreter as heading up all work in soil conservation. When we finally got our terms straightened out, I found the official was in charge of land reclamation, which meant that he was responsible for the drainage of their many swamps. From him I learned that before the war Byelorussia had 21 large dredging machines, all of which were destroyed during the war. Before the war they had drained 675,000 acres of swamp land with these machines, but during the war the drainage systems had deteriorated so that in 1946, the second year after the Germans had been driven out, only 65,000 acres of the former 675,000 acres were usable.

I visited the Byelorussian Research Institute of Land Reclamation and Swamp Management at Minsk, headed by Director Ivan Korotkavich. The Institute has recently been made the center for all swamp management research for the USSR. This is particularly important to Byelorussia since 23 per cent of the republic is complete swamp land with some additional semi-swamp. In the entire USSR, 3.3 per cent of land area is swamp land.

PRIPET MARSHES TO BE DRAINED

The principal drainage problem area in Byelorussia is in the Polesia district, the basin of the Pripet marshes. The Byelorussian government now has plans for draining and cultivating 3.5 million hectares in the Pripet marshes within the next ten to fifteen years. It is estimated that half of the drained area can be used for grasses and feed crops, and the other half for grain and technical crops. These technical crops include hemp, Russian dandelion (a source of rubber substitute), sugar beets, and certain oil seed crops that I was unable to identify from descriptions given.

The Pripet marshes in the Polesian area are flooded from early spring until early August by water from spring rains which originate in the head waters of the Pripet River. The lower reaches of the Pripet River, below the marshes in Polesia, has such a low gradient that it will not drain the marshes rapidly enough. Director Korotkavich explained to me that the problem on the Pripet River was the same as our Missouri River. I did not argue the point with him, but could not recall at that moment where in the Missouri River Basin we had ten million acres of marsh land.

The plans for draining the Pripet marshes are being prepared in three phases: (1) A plan to deepen and widen the Pripet River below the present marshes in order to drain the water faster from the swamp area. (2) The construction of reservoirs in the upper watershed of the Pripet River and its tributaries in order to hold back spring rains from the lowland area now in marshes. (3) Construction of a network of levees within the marsh area in order to hold the river within prescribed banks. Along with the levee system would be required a network of ditches to drain the present marsh area into the river channel.

(*Continued on page 66*)

SEND TODAY for this catalog. It lists and describes the movies, booklets, slide films, wall posters, charts, etc., comprising Case "Visual Education Materials." It also tells how to secure supplies of printed items and to schedule the loan of films. Address Educational Division, J. I. Case Co., Racine, Wis.

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● Here are powerful pieces of ammunition for your campaign to push soil conservation beyond the realm of academic acceptance into the living world of everyday farming. They portray conservation with all the dynamic suggestion of actual procedure and tangible results. Because they inspire and instruct farmers in advanced practices with their own farm tractors and implements, they implant the idea of conservation as a way of normal farming.

Titles of a few educational booklets shown above will suggest the scope of Case materials available. Most of them have parallel films of similar title and subject matter. Some are supplemented by wall posters or charts suitable for exhibits at meetings, and for lecture-study use. In all, the purpose is to be simple, clear, vivid.

Case movies on soil conservation and related practices embody tested methods in detail. They are all in the 16 mm. width, in full color and sound. With their companion booklets for detailed study and permanent reference, they provide both initial stimulus and a follow-through. You are invited to use them.

CASE

RECLAMATION IN BYELORUSSIA

(*Continued from page 64*)

AGRICULTURE RETARDED BY WAR

In general, the soils of Byelorussia are not highly productive. They respond readily to legumes and fertilizers. In 1946 only 15 per cent as much fertilizer was available as before the war. No fertilizer factory was left standing in this republic. The only legume and grass seeds available since the war with which to reestablish rotations were shipped in by UNRRA this spring from Canada, the United States, New Zealand, England and Czechoslovakia. The farmers of this republic were able to plant in 1946 about three-fourths of their pre-war acres. This was done in spite of having available only about 28 per cent as many tractors and only about 40 per cent as many horses as before the war. All of the seeding and much of the land preparation was done by hand. A half-million acres of land were spaded by hand in this republic, which is about the size of Indiana and Illinois. Before the war two-thirds of their plowing was done with tractors, and three-fourths of the grain was seeded and harvested with mechanical equipment including grain drills and combine harvesters. Techniques of grain production, including the science of agronomy, seem to be equally as far advanced as our own. So far as farm life and living conditions are concerned, they are as primitive as ours were 150 years ago. In spite of the extreme devastation in the rural areas, scene of the hardest fighting in all of the war in Europe, these farm people are making a comeback in agricultural production which commands admiration. The Minister of Agriculture, Mr. I. A. Krupenya, after describing their unbelievable farm devstation, made the statement that "spading land by hand and seeding by hand and threshing with a wooden flail, as was done by our forefathers, is a dreary business after having plowed with ten bottom gang plows and having learned to thresh with combines."—Gladwin E. Young, Field Representative, Office of Secretary, U.S.D.A.

Books Received

Some of the books listed will be reviewed in future issues of the JOURNAL.

THE SOIL AND HEALTH. This is a study of organic agriculture by Sir Albert Howard. The book is based on experiences, opinions, and findings of the author. Devon Adair Company, New York. $4.00.

LA CONSERVACION DE LOS SUELOS DE CHILE. The Conservation of the Soils of Chile is written in Spanish. This book outlines the problems of soil erosion and includes a program for a permanent agriculture. It is illustrated. Copies may be obtained from the Minister of Agriculture, Santiago, Chile.

CITIES ARE ABNORMAL. Edited by Elmer Peterson, University of Oklahoma Press, Norman, Oklahoma. 263 pages, $3.00. Twelve experts including Bromfield, Haystead, Sears, Forman, and others indict the modern city as a place in which to live.

PRACTICAL FARMING IN THE SOUTH is a handbook for the small farmer who in addition to his cash crops is trying to raise the food for his family and livestock, improve and conserve his soil, and make the best use of his time and his land. The University of North Carolina Press, Chapel Hill. 526 pages, $2.75.

ELEMENTS OF SOIL CONSERVATION. This text, by Dr. Hugh H. Bennett, offers a clear, comprehensive presentation of the problems of soil erosion and soil exhaustion, and tested methods of solving these problems through modern soil conservation techniques. Very little of the content, particularly the technical information, has been presented in other texts. Questions providing material for classroom discussion follow each chapter. The book also contains a helpful list of correlated visual aids—motion pictures and film strips. McGraw-Hill Book Company, New York. 406 pages, $3.20.

Preserving the land is like flying Old Glory full mast!

Farming the conservation way is not unlike flying Old Glory full mast. For the man who genuinely loves the soil, there is a sense of pride and security in land defended well against the ravages of erosion and constant harvest. As the flag is our emblem of defense against harm from beyond our borders, conservation farming is the pattern for protection against forces, also destructive, within our own land.

John Deere literally has grown up with America. We have seen the land resources of our continent squandered. Working together — all of us — we can prevent further needless destruction of the soil. We can rebuild the wasted land. But we *will* have to *work* at it. We will have to join hands and oppose careless farming, even more effectively than we have heretofore.

John Deere is cooperating in many ways with conservation-minded groups and individuals. We want to help speed this important work. That was our purpose in publishing our educational booklet, SOIL CONSERVATION, which is available from all John Deere branches. Copies are free upon request.

JOHN DEERE • MOLINE • ILLINOIS

"Americans, Wildlife and Their Land"

The above heading was the theme of the Twelfth North American Wildlife Conference held under the sponsorship of the Wildlife Management Institute at the Plaza Hotel, San Antonio, Texas, February 3, 4, and 5, 1947. During the past ten years there has been a growing interest in soil conservation on the part of wildlife managers, sportsmen, fish and game officials and others concerned with America's creatures of the wild. That interest culminated in the program of the Wildlife Conference which stressed "incentives for wildlife and the more lasting benefits of good land use." The Founder of the Soil Conservation Society gave one of the keynote addresses and the technical sessions of the Conference included discussions of the wildlife of grasslands, forest, farm and ranch, inland and marine fisheries. There was a special session on "Wildlife and Land-use Concepts." Four General Sessions covered the land, education, and business in relation to wildlife as well as the currently controversial subject "Is Waterfowling on the Way Out?"

This important national meeting emphasized the widespread influence of the activities of the soil conservationist and illustrates one of the ways in which special interests are contributing to proper use of our land resources. All of the material presented at the twelfth annual meeting will be published by the Institute in the Transactions of the Conference.

CORRECTION

The last sentence on page 18 of the second paragraph in the article by Carl B. Brown, Volume 1, Number 1 of the JOURNAL should read: "For example, if we built a reservoir with 100 acre-feet of storage the C/W ratio would be 1.0 and the annual silting rate would be 100 per cent.

It is impossible to exaggerate the importance of crumb formation in soils. Soil crumbs represent life to the plant and the soil; when they fall down to dust it means death, for the dust is easily blown or washed away and soil erosion sets in.

—Sir E. John Russell, Director,
Rothamsted Experimental Station, England.

SOIL CONSERVATION SOCIETY OF AMERICA

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